E III
F (1)

FORM AEC-591 (6/71)

UNITED STATES ATOMIC ENERGY COMMISSION
~~DIVISION OF COMPLIANCE~~
Directorate of Regulatory Operations

INSPECTION FINDINGS AND LICENSEE ACKNOWLEDGMENT

1. LICENSEE		2. REGIONAL OFFICE
Kerr-McGee Corporation Kerr-McGee Building Oklahoma City, Oklahoma 73102		U S ATOMIC ENERGY COMMISSION [redacted] 10395 W. COLFAX, ROOM 200 DENVER, COLORADO 80215
3. DOCKET NUMBER(S)	4. LICENSE NUMBER(S)	5. DATE OF INSPECTION
40-8006	SUB-986	

6. INSPECTION FINDINGS

The inspection was an examination of the activities conducted under your license as they relate to radiation safety and to compliance with the Commission's rules and regulations and the conditions of your license. The inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector. The findings as a result of this inspection are as follows:

☒ No items of noncompliance or unsafe conditions were found.

The following items of noncompliance related to records, signs, and labels were found:

☐ A. Rooms or areas were not properly posted to indicate the presence of a RADIATION AREA. 10 CFR 20.203(b) or 34.42

☐ B. Rooms or areas were not properly posted to indicate the presence of a HIGH RADIATION AREA. 10 CFR 20.203(c) (1) or 34.42

☐ C. Rooms or areas were not properly posted to indicate the presence of an AIRBORNE RADIOACTIVITY AREA. 10 CFR 20.203(d)

☐ D. Rooms or areas were not properly posted to indicate the presence of RADIOACTIVE MATERIAL. 10 CFR 20.203(e)

☐ E. Containers were not properly labeled to indicate the presence of RADIOACTIVE MATERIAL. 10 CFR 20.203(f) (1) or (f) (2)

☐ F. A current copy of 10 CFR 20, a copy of the license, or a copy of the operating procedures was not properly posted or made available. 10 CFR 20.206(b)

☐ G. Form AEC-3 was not properly posted. 10 CFR 20.206(c)

☐ H. Records of the radiation exposure of individuals were not properly maintained. 10 CFR 20.401(a) or 34.33(b)

☐ I. Records of surveys or disposals were not properly maintained. 10 CFR 20.401(b) or 34.43(d)

☐ J. Records of receipt, transfer, disposal, export or inventory of licensed material were not properly maintained. 10 CFR 30.51, 40.61 or 70.51

☐ K. Records of leak tests were not maintained as prescribed in your license, or 10 CFR 34.25(c)

☐ L. Records of inventories were not maintained. 10 CFR 34.26

☐ M. Utilization logs were not maintained. 10 CFR 34.27

☐ N. Records of radiation survey instrument calibration were not maintained. 10 CFR 34.24

☐ O. Records of teletherapy electrical interlock tests were not maintained as prescribed in your license.

☐ P. Other ______

______
(AEC Compliance Inspector)

7. The AEC Compliance Inspector has explained and I understand the items of noncompliance listed above. The items of noncompliance will be corrected within the next 30 days.

8509100020 850702
PDR FOIA
KLINKNET85-84 PDR

______ (Date) ______ (Licensee Representative – Title or Position)

ORIGINAL TO LICENSEE

INSPECTION DATA

1. Inspector: Hyder

2. Date of Inspection: 5-26-72

3. Licensee: Kerr-McGee

Address: Oklahoma City

4. License No. SUB-986 Docket No. 40-8006

Category E

Priority III

Initial

Reinspection

Followup

Inquiry

Investigation

Noninspectable

Date Dispatched

5. AEC-591 ✓ Clear ✓ Noncompliance

6. Regional Office Enforcement Letter

Noncompliance with 10 CFR License Condition(s)

7. Referred to HQ for Action

Reason:

8. Next Recommended Inspection Date: May 1975

Licensee Kerr-McGee SUB-986

Summary

No change from previous inspection

Noncompliance and Safety Items

None

Unusual Occurrences

None

Status of Previously Reported Noncompliance or Safety Items

No previous item

Management Interview

Clean 591 issued to Mr C Long acting Director

Licensee Kerr-McGee SUB-986

DETAILS

A. Participants

Mr A M Valentine RSO

B. Scope of License Program

No change

C. Organization

No change

D. Administrative Control

No change

E. ~~Use of Material~~ ~~Change~~ Use of Material

No change

Licensee Kerr-McGee SNM-986

F. Facilities

No change

G. Equipment

No change

H. Radiological Safety Procedures

No change

I. Personnel Monitoring and Exposure to External Radiation

No change

J. Exposure of Employees to Concentrations of Radioactive Materials

No change

Licensee Kerr-McGee Sect. 4-26

K. Effluents to Unrestricted Areas

No change

L. Disposals

~ 475 # U_3O_8 Transferred to Sequoyah Facility.

M. Miscellaneous Surveys, Evaluations, and Records

No change

N. Special License Conditions

No change

O. Posting and Labeling

Area posted CRM

Licensee Kerr - McGee   Sec. 4.86

P. Independent Measurements

None made

Q. Operations Observed

None observed

R. Incidents, Overexposures, Theft or Loss, Equipment Malfunction

None identified or reported

S. Other Information or Continuation from Previous Paragraphs

None

JEH

INSPECTION REPORT

1. Name and address of licensee
Kerr-McGee Corp
Kerr-McGee Building
Oklahoma City, Oklahoma

2. Date of inspection
May 26, 1972

3. Type of inspection
Reinspection

4. License number(s), docket number(s), number and date of last amendment for each license. Category and Priority of each license
SUB-986 (Docket # 40-8006) E III
Amendment #1 issued 4-23-71

5. Date of previous inspection 3-25-70

6. Is "Company Confidential", or proprietary, or classified information contained in report?
Yes ______ No X
(Specify paragraphs)

7. Scope of inspection
Toured Facilities
interviewed those responsible for administration & radiation safety aspects of program
Review records

8. Hyder — Inspector — 6-11-72 — Date of Report

CHL — Reviewer — 7/12/72 — Date of Review

1

E III
R (1)

FORM AEC-591
(6/71)

UNITED STATES ATOMIC ENERGY COMMISSION

~~DIVISION OF COMPLIANCE~~
Directorate of Regulatory Operations

INSPECTION FINDINGS AND LICENSEE ACKNOWLEDGMENT

1. LICENSEE	2. REGIONAL OFFICE
Kerr-McGee Corporation Kerr-McGee Building Oklahoma City, Oklahoma 73102	U. S. ATOMIC ENERGY COMMISSION REGION IV, [redacted] ICE 10395 W. COLFAX, ROOM 200 DENVER, COLORADO 80215

3. DOCKET NUMBER(S)	4. LICENSE NUMBER(S)	5. DATE OF INSPECTION
40-8006	SUB-986	

6. INSPECTION FINDINGS

The inspection was an examination of the activities conducted under your license as they relate to radiation safety and to compliance with the Commission's rules and regulations and the conditions of your license. The inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector. The findings as a result of this inspection are as follows:

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☐ D. Rooms or areas were not properly posted to indicate the presence of RADIOACTIVE MATERIAL. 10 CFR 20.203(e)

☐ E. Containers were not properly labeled to indicate the presence of RADIOACTIVE MATERIAL. 10 CFR 20.203(f) (1) or (f) (2)

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☐ H. Records of the radiation exposure of individuals were not properly maintained. 10 CFR 20.401(a) or 34.33(b)

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☐ J. Records of receipt, transfer, disposal, export or inventory of licensed material were not properly maintained. 10 CFR 30.51, 40.61 or 70.51

☐ K. Records of leak tests were not maintained as prescribed in your license, or 10 CFR 34.25(c)

☐ L. Records of inventories were not maintained. 10 CFR 34.26

☐ M. Utilization logs were not maintained. 10 CFR 34.27

☐ N. Records of radiation survey instrument calibration were not maintained. 10 CFR 34.24

☐ O. Records of teletherapy electrical interlock tests were not maintained as prescribed in your license.

☐ P. Other ____________________

____
(AEC Compliance Inspector)

7. The AEC Compliance Inspector has explained and I understand the items of noncompliance listed above. The items of noncompliance will be corrected within the next 30 days.

____________________ ____________________
(Date) (Licensee Representative – Title or Position)

ORIGINAL TO LICENSEE

INSPECTION DATA

1. Inspector: Hyder — Category E
2. Date of Inspection: 5-26-72 — Priority III
3. Licensee: Kerr-McGee — Initial ____

Reinspection ____

Address: Oklahoma City — Followup ____

Inquiry ____

4. License No. SUB-986 Docket No. 40-8006 — Investigation ____

Noninspectable ____

Date Dispatched ____

5. AEC-591 ✓ Clear ✓ Noncompliance ____

6. Regional Office Enforcement Letter ____

Noncompliance with 10 CFR ____ License Condition(s) ____

7. Referred to HQ for Action ____

Reason: ____

8. Next Recommended Inspection Date: May 1975

Licensee Kerr-McGee SNB-986

Summary

No change from previous inspection

Noncompliance and Safety Items

None

Unusual Occurrences

None

Status of Previously Reported Noncompliance or Safety Items

No previous item

Management Interview

clear 591 issued to Mr C Long acting Director

Licensee Kerr-McGee SUB-986

DETAILS

A. Participants

Mr A M Valentine RSO

B. Scope of License Program

No change

C. Organization

No change

D. Administrative Control

No change

E. ~~Use of Material~~ ~~[illegible]~~ Use of Material

No change

Licensee Kerr-McGee SUB-986

F. Facilities

No change

G. Equipment

No change

H. Radiological Safety Procedures

No change

I. Personnel Monitoring and Exposure to External Radiation

No change

J. Exposure of Employees to Concentrations of Radioactive Materials

No change

Licensee Kerr-McGee   Sub 986

K. Effluents to Unrestricted Areas

No change

L. Disposals

~ 475 # U_3O_8 Transferred to Sequoyah Facility

M. Miscellaneous Surveys, Evaluations, and Records

No change

N. Special License Conditions

No change

O. Posting and Labeling

Area posted CRM

Licensee Kerr - McGee SUA 486

P. Independent Measurements

None made

Q. Operations Observed

None observed

R. Incidents, Overexposures, Theft or Loss, Equipment Malfunction

None identified or reported

S. Other Information or Continuation from Previous Paragraphs

None

JEH

INSPECTION REPORT

1. Name and address of licensee

   Kerr-McGee Corp
   Kerr-McGee Building
   Oklahoma City, Oklahoma

2. Date of inspection

   May 26, 1972

3. Type of inspection

   Reinspection

4. License number(s), docket number(s), number and date of last amendment for each license. Category and Priority of each license

   SUB-986 (Docket # 40-8006) E III
   Amendment #1 issued 4-23-71

5. Date of previous inspection 3-25-70

6. Is "Company Confidential", or proprietary, or classified information contained in report?

   Yes _____ No X

   (Specify paragraphs)

7. Scope of inspection

   Toured Facilities
   interviewed those responsible for administration & radiation safety aspects of program
   Review records

8. Hyder — Inspector; 6-11-72 — Date of Report

   CWL — Reviewer; 7/12/72 — Date of Review

KERR-McGEE CHEMICAL CORP.
258 ANN STREET • WEST CHICAGO, ILLINOIS 60185

231-0760

June 13, 1972

U. S. Atomic Energy Commission
Washington, D. C. 20545

Attention: Mr. Don F. Harmon
Source and Special Nuclear Materials Branch
Division of Materials Licensing

Amend. 2

Docket No. 40-2061
License No. STA-583

Gentlemen:

Enclosed herewith is a description of procedures, in accordance with Condition 8 of the subject license, revised as of June, 1972 to reflect process and other changes made since the date of the current license application. Also enclosed is Exhibit I, Drawing No. C11083-4 revised to show additions in waste disposal facilities.

These revisions have been made at the request of the Division of Compliance, Region III, and supercede documents now in Commission files.

Please advise the undersigned should you have any questions regarding these documents.

Yours truly,

O. L. Daigle
Plant Manager

OLD/fw
Encls.
cc: Mr. Boyce H. Grier, Regional Director, USAEC

JUN 1 5 1972

LINDSAY RARE EARTHS

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1. (A detailed description of your organization, including authority and responsibility of each level of management and/or supervision in regard to development, approval, and adherence of operating procedures.)

   The authority and responsibility for developing our operating procedures is assigned to our Technical Services Department. Approvals are required by the Manager, Technical Services; Manager, Plant Engineering, Radiation Safety Officer; Manager, Production and Plant Manager. A safety committee review of the procedure is made prior to approvals. Approved procedures are subject to review and audit by the Nuclear Division Health and Safety Coordinator.

   The General Foremen and line supervisors have the responsibility of assuring adherence to the operating procedures. As an aid to the supervisor, safety inspections are conducted by committees and individuals. Processes are reviewed as required by the Technical Services Department.

2. (The qualifications and experience of the personnel in your organization assigned the responsibility for developing, conducting and administering the radiation safety program for the plant.)

   The responsibility for developing, conducting and administering our radiation safety program is with the Radiation Safety Officer. He has a degree in chemistry and has several years experience in the inorganic chemical field.

   Reporting to the Radiation Safety Officer is a "Radiation Hygienist." This person has received formal training in health physics by completing courses in radiation detection and measurements and radioisotope chemistry at Aurora College, Aurora, Illinois.

   Supervisors have a minimum of a high school education and report to chemists or chemical engineers. Supervisors receive Safety and Radiation Protection training.

The Radiation Safety Program is reviewed and audited by the Nuclear Division Health and Safety Coordinator who has eight years of varied health physics experience and an M.S. degree in Radiation Biophysics.

3. (A description of the area in which the plant is located, including the size of nearby inhabited areas, location of wells, streams and rivers, flood stage levels of streams and rivers, and sources of water supply for the plant. A topographical map with the above identification is preferred.)

A composite USGS topographical map is attached as Exhibit I. The map is made up of portions of the West Chicago and Naperville, Illinois quadrangles in which the City of West Chicago and properties of the Rare Earth Plant, Kerr-McGee Chemical Corp. lie. The extent of the latter properties and the location of municipal and Division water supply wells are delineated on a transparent overlay positioned on the map.

The Plant's physical location is on the southwest side of the City of West Chicago. Several private homes border the property on the north and east, and the Elgin, Joliet & Eastern RR borders it on the west. Other private homes are located to the west of the railroad property.

The elevation above sea level of the municipality ranges from 730 feet to 784 feet, the latter being the elevation at the West Chicago City Hall. The elevation of the Plant's property is from 750 feet at the main plant location, on the north, to slightly under 730 feet in the disposal area, on the south.

The principal streams within a five mile radius of the plant are the DuPage River (west branch) on the east and Kress Creek on the west and south. The latter flows into the DuPage about two miles south of the plant. At their closest points, the DuPage River is one mile from the Plant's disposal ponds and Kress Creek, one half mile. Both streams flow in a southerly direction.

The streams have no history of serious flooding. According to one authority (U. S. Corps of Engineers) the highest level or elevation on record for the DuPage River as measured at the gaging station at U. S. Highway 64, two miles north of the City, is 728.1 feet reached in June, 1967. There are no corresponding figures available for the DuPage at the sewage treatment plant, southeast of the City, or at its confluence with Kress Creek, but the same authority estimated that these would have been much lower.

4. (A description of the method for restricting both the plant and waste disposal area from unauthorized entry.)

The plant and waste disposal areas are surrounded by cyclone type fencing. Gates in the fence are kept locked except when in use. Employee and visitor entrance doors are open during business hours and a clerk-receptionist controls the entry of individuals. These doors are locked after business hours and only responsible persons can gain entry by using special keys issued for this purpose. Watchman tours are conducted during non-business hours. Watchclock key stations are located within the plant, out-of-doors,and in various out buildings.

5. (A description of your waste disposal procedures. Where retention systems such as levees, dikes, ponds, etc., are used to prevent the release of liquid or solid waste containing radioactive material to offsite areas, describe the retention capability and integrity of the system, conditions that might lead to accidental release of the waste, the environmental effects of such a release and your program of inspection and maintenance to prevent such accidental occurrences. This description should also include drawings showing the layout, heights, top width, side slopes, freeboard, seepage control, protection of embankment surfaces, foundation design, typical cross-sections, characteristics of fill material and a discussion of construction methods and specifications.)

Solid trash type waste which may be contaminated with thorium material is kept separate from non-contaminated refuse. Monazite ore bags and a very small amount of other combustible material are burned in an incinerator. Non-contaminated refuse and scrap, and decontaminated scrap, are removed from the premises by a scavenger service.

Prior to removal all scrap equipment which has been used in thorium processing operations is surveyed and if needed, decontaminated to levels below the limits set forth in an A.E.C. document titled "Radioactivity Contamination Limits for Abandonment of Facilities and Equipment" as follows:

RADICACTIVITY CONTAMINATION LIMITS FOR ABANDONMENT OF FACILITIES AND EQUIPMENT

1. The maximum amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 25,000.

2. The average amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 5,000.

3. The maximum amount of removable (capable of being removed by wiping the surface with a filter paper or soft absorbent paper) alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 1,000.

4. (a) The maximum level at one centimeter from the most highly contaminated surface of a building or piece of equipment measured with an open-window beta-gamma survey meter through a tissue equivalent absorber of not more than seven milligrams per square centimeter should not exceed one millirad per hour.

   (b) The average radiation level at one centimeter from the contaminated surface of the building or equipment measured in the same manner should not exceed 0.2 millirad per hour.

5. The contamination limits for abandonment of facilities involving U-233, or plutonium should not exceed 1/10 of the limits in items 1, 2 and 3 above.

Solid chemical residue composed mainly of silica, unreacted monazite, zircon, rutile, calcium sulfate and barium sulfate, and other gangue is piled on the ground in our waste disposal area at the southwest corner. This material is of a very sticky, pasty nature which dries to a hard cake. It does not have a tendency to dust or dry to a powder and is extremely insoluble. This pile does emanate some radiation. Survey meter readings taken at the fence line adjacent to the pile have never exceeded 2.5 mr per hour. The areas south and west of the fence are not inhabited. Parallel to, and about 25 ft. from the west fence is a railroad right-of-way.

The radiation dosage to anyone on a passing train is negligible. Observations over a period of several years have shown that pedestrians very seldom use the railroad right-of-way. However, if it is assumed that a person makes four trips per day every day at three miles per hour along the 400 ft. of fence in question and that the dose rate is 2.5 mr/hr, the dose received would be less than 0.1 rem per year.

Pursuant to section 20.105 (a) we request allowance to produce a radiation level in the unrestricted area at the southwest boundary of our waste disposal area of not more than 2.5 mr per hour.

Attached as Exhibits II and III are Drawings C-11083-4 and B-12016. These show the Plant property in some detail, and graphically describe liquid waste disposal methods and procedures.

Inorganic liquid wastes generated in plant operations are discharged into surface trenches within the enclosed plant area. These discharge into a collecting basin or sump (Bldg. 14). Automatically operated pumps transfer the waste via underground and surface piping to a series of five settling and seepage ponds located approximately 750 feet south of the main plant area.

Pond No. 1, the largest, is used primarily for settling entrained solids and post precipitates, and receives the pumped waste directly from Bldg. 14. Clarified waste is pumped to either/or Pond Nos. 2, 3, 4 or 5 for seepage and disposal. The level in Pond No. 1 is automatically maintained by the pump, and levels in the other ponds are controlled below the established free board point by manually valving off individual transfer lines.

Surface trenches within the enclosed plan area are constructed of concrete and lined with acid brick. Trenches are generally covered.

Underground conduit, in the most part, consists of 54 inch diameter reinforced concrete pipe lined with acid brick. In transition zones and a few other areas, the conduit is rectangular and again constructed of concrete lined with brick.

The collecting basin or sump is approximately 20 feet deep and has a holding capacity of 50,000 gallons. It is constructed of reinforced concrete and lined with acid brick.

The underground transfer line from the sump (Bldg. 14) to the disposal ponds is a 6 inch rubber-lined, steel pipe. It outcrops in the vicinity of Pond No. 2 and is connected to a 6 inch reinforced rubber hose laid above ground and discharging into Pond No. 1. Similar hoses run from the pumping station on Pond No. 1 to the other ponds.

Pond construction, holding capacity and other data are as shown in Exhibit III, Drawing B-12016.

All parts of the liquid waste disposal system are well inspected and maintained. Trenches, conduit and sump are cleaned and inspected annually, and repaired as indicated. Pumps and piping are checked daily, and transfer lines and ponds are inspected at least once every 8 hour work shift. Ponds are dredged, as needed, to remove accumulated sludges.

6. (A description of the geological and hydrological characteristics which may affect the degree and mode by which liquid wastes may reach underground and/or surface waters. This should include estimates of local evaporation and seepage rates, depth of the local water table and permeability characteristics of underlying material.)

   As shown on the attached Exhibits II and III and described under "No. 5," inorganic liquid wastes are essentially all disposed of in seepage ponds. Some evaporation of the ponded waste takes place but because of climate and humidity conditions it is doubtful that the amount is significant.

   The ground in which the ponds are located consists of several strata of soils having varying degrees of permeability. The most permeable is the coarse sand and gravel stratum which forms the base or floor of the ponds. The uppermost or topsoil has fair to poor permeability, and the clay stratum underlying the gravel has very poor permeability. It is doubtful that much seepage takes place in either of these strata.

   Seepage rates vary from 0.2 to 0.5 gal/sq.ft/hour. These appear to be low, considering the permeability of the gravel, but sludge settled in Pond No. 1 or small amounts that may be carried over into the other ponds impede outflow to some degree. Ground water levels also affect seepage. The current ground water elevation, as reported by the Illinois State Water Survey, averaged 726 feet in the West Chicago area. This will vary according to seasons and will be lowest in the fall and highest in the spring of the year.

7. (A description of the liquid effluent survey program (assuming plant effluents reach subterranean or surface water supplies), including the number, location and frequency of check samples and procedures for the sample analysis of natural thorium and radium-228.)

Liquid effluent samples are obtained daily. A one quart grab sample is obtained from the overflow hose which drains the settling pond (Pond #1). The sample is taken at the discharge end of the hose immediately before it enters the seepage pond (Pond #2). The seven samples per week are composited into a weekly sample.

The composite sample is allowed to stand until the very little amount of solids settle to the bottom of the jar. A 1 ml sample of the clear liquid is evaporated in a 1.25 inch stainless steel planchet for alpha counting. This sample contains the soluble radioactive material, if any.

The composite sample is then thoroughly stirred, suspending the solids. While stirring, a 1 ml sample is taken and dried in a planchet. This sample contains the soluble and insoluble radioactive material, if any.

The samples are alpha counted (windowless) for 1 hour. A one hour background is counted immediately before each sample, and another background is counted after each sample. Assuming the before and after background counts are reasonably the same, the average background count is determined and deducted from the sample count. Should the before and after background counts not reasonably agree the counting is repeated.

The corrected counts of the sample "soluble only" is deducted from the corrected counts of the sample "soluble and insoluble" the difference being considered to be "insoluble only."

Aged thorium nitrate is dissolved in water to a concentration of 10^{-6} μci/ml. One ml of this solution is dried in a planchet. One hour before and after backgrounds are alpha counted with the thorium reference sample between.

The water sample counting data is corrected for background and divided by the corrected reference sample counts. Results are reported as μci/ml thorium (nat.).

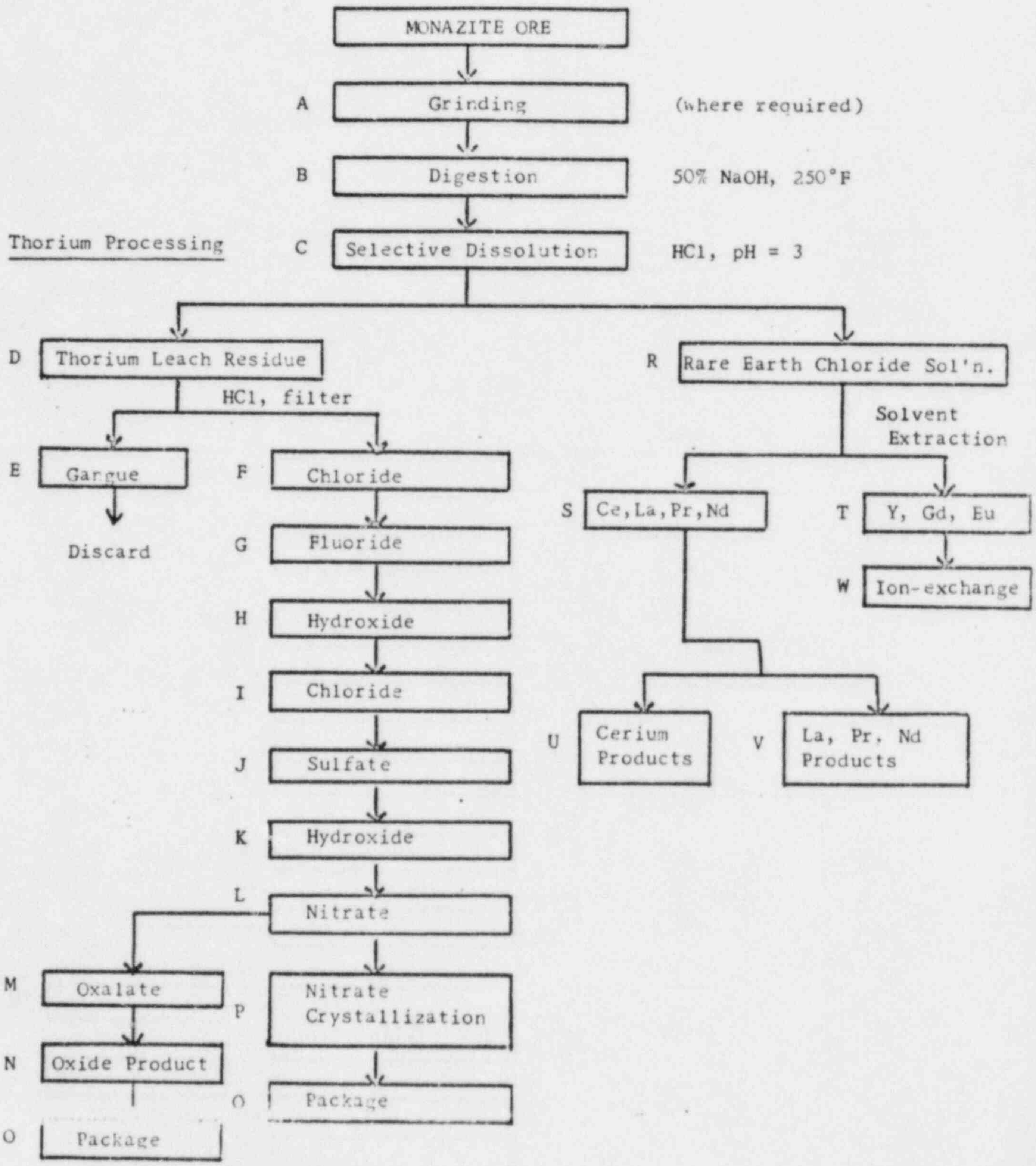
For a period of over a year during 1967 and 1968, waste effluent was radio assayed on a daily basis. Of 475 daily samples assayed for soluble radioactivity 306 were reported as N.D. and the average concentration was 0.12×10^{-6} µci/ml. The insoluble portion was assayed as well. 285 of the samples for insoluble radiation were N.D. and the average concentration was 0.36×10^{-6} µci/ml.

Most N.D. results reported are equal or nearly equal to background. Results less than 10^{-7} µc/ml are also reported as N.D.

Additional environmental water samples are collected monthly from the plant storm sewer system and nearest river. These samples are analyzed by the described procedure for thorium and to date there is no evidence of thorium contamination in these streams.

8. (A flow diagram of e plant production operation (a diagram of the plant layout, indicating areas and points in the process here dust is generated).

The process essentially is the caustic digestion method for extracting rare earth and thorium values from monazite ore.



9. (A description of dust collection and ventilation equipment that are utilized during plant operation, including type, capacity and location of such equipment, eg., ore transfer points, crushing, grinding, etc., and an analysis of the efficiency of the equipment as designed to control or prevent the release of airborne radioactivity to the environs.)

Dust collection equipment is indicated on the floor plans by a star (*). The star indicates the point of operation where airborne radioactivity is generated and thence collected.

A. Ore may or may not be ground, depending on quality. The grinding operation is provided with ventilation control and dust collecting equipment which prevents airborne radioactivity exposure in excess of CFR-20 limits for the operator or operators who attend the operation and for unrestricted areas.

   Ore is not ordinarily roasted, although equipment is available for this. (See floor plan titled "Sand Roasting Shed-Bldg. 4A.") A Dracco 52 bag collector and a Schneible Multiwash Scrubber are located on the roof of Building 4A. Dust laden air is filtered through the bag collector. The filtered air then passes through the scrubber and the dust free air is then discharged to the atmosphere. The system loading is approximately 12,500 C.F.M. The air relocities at the various hoods (*) have a minimum of 125 F.P.M. Capture velocity is approximately 100 F.P.M. During past operations several hundred air samplings have been taken resulting in no overexposures for any of our personnel.

B. Ore is placed into a Monazite sand hopper (see floor plan titled "Bldg. 9 1st Floor area"). The ore is lifted to the 4th floor by a bucket elevator. The sand hopper is hooded and ducted to a Dracco 3-compartment No. 40 bag collector which is located on the 4th floor roof.

The elevated ore is discharged into a surge bin. (See floor plan "Bldg. 9 Fourth Floor Equipment Layout.") The surge bin discharged into charging buckets positioned on a weighing scale. This operation is enclosed in a hood ducted to the dust collector.

Air velocities at the face of the hoods are:

1.	1st Floor Sand Hopper Hood	135 F.P.M.
2.	4th Floor Weighing Station	110 F.P.M.

Capture velocity is approximately 75-100 F.P.M., and the system loading is approximately 8,000 C.F.M.

Hundreds of air samplings have shown no excessive exposures to airborne radioactivity for our personnel working at the sand hopper or weighing station.

The charging buckets are emptied into reaction pots containing hot liquid caustic soda. Vapors and gases from the reaction are exhausted from the pots, and scrubbed in wet scrubbers before discharge to the atmosphere.

From this point through many process steps there is no significant airborne radioactivity problem.

J. (Flow diagram Step J - Thorium Sulfate)

Thorium sulfate is slowly crystallized from a thorium chloride solution using mild air agitation and a lightening stirrer. Water vapor containing a small amount of hydrochloric acid is evolved. This vapor is passed through a packed, wet caustic scrubber and exhausted into an 80' high general purpose exhaust stack. (See floor plan "Bldg. 9, 3rd Floor Layout."

L. (Flow diagram Step L - Thorium Nitrate)

This part of the process is serviced by a scrubber. (See floor plan "Bldg. 9, 2nd Floor Equipment Layout.")

Thorium nitrate feed solution is evaporated in kettles to concentrate the solution. Upon cooling, crystals of thorium nitrate are formed. During the evaporation water vapor containing oxides of nitrogen are evolved. The kettles are completely enclosed in a hood which is ventilated to a packed tower scrubber with a caustic scrub to remove the small amount of nitrogen oxides. The scrubber discharges into the general process exhaust system.

The scrubber loading is 4300 C.F.M. and air velocities measured at the opened inspection door in the hood panel are greater than 200 F.P.M.

M,N,O. (Flow diagram Steps M, N, & O - Thorium Oxide)

(See floor plan "Thorium Oxide Rooms - Bldg. 3.")

Damp thorium nitrate crystals are dissolved in water and oxalic acid added to precipitate thorium oxalate. This slurry is filtered and the damp cake is spread on trays and dried in a tray drier. The water vapor is vented directly to the atmosphere.

The trays of dried oxalate are placed under a hood and the product is scooped into ceramic ignition saggers. The saggers are placed into a muffle furnace where the oxide is formed. A slot hood shroud is fixed around the furnace door to remove dust which may occur during loading and unloading the furnace.

After ignition and cooling the saggers are dumped into a blending drum. A slot hood removes dust generated when dumping. After blending, the blending drum outlet valve is alternately opened and closed to fill the final package. A dust vent removes dust during packaging.

The various hoods and vents used in these operations are ducted to a Brady Dust Filter Model 1375.

The air velocities at the face of the various hoods are as follows:

Dried Oxalate Hood		300 FPM
Furnace Slot Hood		300 FPM
Saggers Dumping Hood		130 FPM
Packaging Dust Vent	Above	300 FPM

System loading is approximately 6100 CFM.

The Brady dust filter collector is located 60 yards north of the Building 3 thorium oxide room. It is contained in a separate room as shown on the drawing titled "Bldg. #1 Floor Equipment Layout."

10. & 11. (A description of the survey program which is followed to determine concentrations of airborne radioactivity within the plant, including the make, model number and capacity of sampling devices, and your procedure for sample analysis. Include a description of:
   a. Each sampling location in respect to operating personnel.
   b. Each sampling location in respect to process operation.
   c. The frequency (for a & b).
   d. Surveys made during maintenance operations.)

Concentrations of airborne radioactivity within the plant are determined for the following:

A. Breathing zone of the operator while at the point of operation where dusty radioactive material is handled. (5 minute air sample)

B. Specific work area the operator occupies when not at the point of operation. (1 hour air sample)

C. General plant areas which the operator or others may occasionally or frequently occupy. (1 hour air sample)

D. During maintenance of thorium processing equipment containing dusty material.

Many of the operations are quite intermittent. Air samplings are not taken at the point of operation during down time. General air samples are obtained, however, in each building and on each building floor which contains thorium operations, unless these areas are shut down and only rarely occupied. A general air sampling is also made in a non-thorium operating area for "background" information. General air samples are taken monthly.

Breathing zone, point of operation air samples are indicated by solid circles on the attached floor plans. These samples are taken at one-half of the points shown every other week in such a manner that a sample is taken at each point once each four weeks, except at those points where no operations are conducted during the four week period.

A specific work area sample is taken whenever a breathing zone sample is found to contain more than 3×10^{-11} µc/ml natural Th, 7×10^{-10} µc/ml Ra224, 1×10^{-7} µc/ml Bi212, or 3×10^{-7} µc/ml Rn220. Under these circumstances the operators time in the various areas he occupies is documented, and his potential 40 hour exposure calculated.

Upon learning that maintenance work is needed on equipment containing radioactive material an assessment is made of the particular job in question. If it is determined that a potential airborne contamination problem could exist then an air sampling program is established after all efforts are made to minimize the problem.

We have three air sampling devices which were designed and constructed by our personnel. Each sampler has a timer, an air pump, flow meter, air flow adjustment, and a filter paper holder. The air flow meter is calibrated using a gas meter. The air sampler is set to draw 35 liters of air per minute through a Whatman No. 41 paper which is 1.25 inch in diameter.

We use a gas flow proportional alpha counter in the "windowless" position to analyze our air samples.

Alpha counting is done as follows:

I. In cases where daughter activity is <u>more</u> than negligible and at any new point of operation, the standard formula for computing activity is:

μ Ci/ml = C/M x d/c x 1/T x 1/V x 1/0.7 x 1/K

Where C/M = counts per minute from the sample.

d/c = disintegrations per count (from alpha standard source)

T = Sampling time (minutes)

V = Volume sampled (= 35,000 ml)

1/0.7 = Filter paper absorption factor

and K = factor for converting d/m to μ Ci (= 2.22×10^6)

A. The sample is counted 1 hour after sampling and the gross activity calculated using the standard formula. At this point in time the Rn220 has died off and most of the alpha count is due to Bi212.

B. The sample is counted again 10.6 hours after sampling. This is a half-life of Pb212 and half of the Bi212 is also gone. Both of these at this point are the result of half of the Rn220 originally present.

1. The standard formula times 2 = Rn220 activity.

2. To obtain the Bi212 activity the standard formula calculation is multiplied by 0.9. This product is subtracted from the gross activity found in A, and the difference is multiplied by 2.

C. The sample is counted again 106 hours after sampling.

This is 10 half-lives of Pb212 and all of the short lived daughters originally present are gone.

The standard formula is calculated and divided by 1.7 = Ra224 activity.

D. The sample is counted again 465 hours after the sample was taken. At this point an apparent equilibrium has been established and we have nearly 6 alpha activity which is close to the amount at secular equilibrium.

$$\text{Th(nat)activity} = \frac{\text{Standard formula} - .1\ \text{Ra224 activity}}{5.9}$$

II. In cases where daughter activity is negligible counting is done 106 hours after the sample was taken.

The standard formula is divided by 6 to obtain the Th(nat) activity.

III. Each day the alpha standard is counted to assure that the counter is reliable.

Sample and background counts are properly taken to assure a 95% confidence level. We should detect a minimum of $9X10^{-11}$ μc/ml Rn220 and/or Bi212. For Th(nat) we should detect 2×10^{-12} μc/ml, and for Ra224 7×10^{-11} μc/ml. This applies to a 5 minute sample time. An hour sample would show at least 10 times greater sensitivity.

12. (A description of the procedure followed in determining the average daily and weekly exposures to airborne radioactivity for each employee who frequently or occasionally occupies areas where air contamination exceeds M.P.C. values specified in 10 CFR 20.)

We are not now using any operation which continuously causes an airborne concentration in excess of 3×10^{-11} μc/ml of natural thorium in a restricted area during a 40 hour work week outside of ventilation control equipment.

There are a few operations which may for short periods of time exceed 3 x 10^{-11} µc/ml of natural thorium in the air at the point of operation. Thus there is a possibility that on a 40 hour basis an airborne concentration greater than 1 M.P.C. might exist.

Whenever a 5 minute operators breathing zone sample shows greater than 3 x 10^{-11} µc/ml of natural Th the operators time at the point of operation is calculated. A 1 hour air sample is taken in the environs of the area where the operator spends most of his time. The time weighted exposure including the breathing zone sample and general air sample is calculated. If the calculations show that an average of 1 M.P.C. could be exceeded during a 40 hour work week then immediate steps are taken to correct the problem. If ventilation control equipment is found deficient it is repaired. If the operators handling methods are improper he is re-instructed. As a last resort employee rotation may be used.

It is extremely rare that a general area air sample exceeds 1 M.P.C. and these operating areas are occupied so little by personnel, other than the operator, that we do not propose to document the time of an occasional occupant.

13. (If treatment or disposal of licensed material by incineration is anticipated, an application should be made in accordance with 10CFR20 sec. 20.305.)

In conformance with 10CFR20.305 we request that our license include a provision enabling us to incinerate monazite ore bags and other combustible trash.

We use a hand fed Model Co-200 incinerator equipped with a gas after burner built by the C.O. Hendrikson Company. The following data applies:

a. Trash burning capacity of incinerator - 200 lbs/hr.
b. Exhaust gas volume in stack corrected to 70°F - 300 C.F.M.
c. Stack height - 30 ft.
d. Particulate emission-0.17 grains per standard cubic foot.
e. Expected maximum operating time - 10 hrs/wk.

f. Micro curies (Th(nat) of exhaust gas within stack - 8×10^{-12} µc/ml (corrected to $70^{o}F$).
g. Expected yearly average concentration of Th(nat) within stack gas - 0.46 M.P.C. (Background neglected).
h. Ash & residue (monazite sand) - 20% of trash weight.
i. Thorium content of ash & residue - 6% (1.2% of trash weight).

Before incineration the operator cleans out the ash from the previous days burning. The ash & residue is placed in boxes or drums and stored for possible future reclaiming of values.

Twice monthly, an hour-long air sampling in the general operator work area is made and the exhaust stack is sampled for radioactivity in the particulate emission.

14. (A description of plant discharge stacks including stack heights, types and concentrations of effluents discharged, method for controlling release of radioactive material, and methods for determining the concentration of radioactive material released to the environs.)

We have a total of 10 stacks which service our thorium operations. These are:

1. Bldg. 9-General purpose process exhaust system, 3rd floor roof. This stack is 80 ft. from ground level. Many processing tanks are connected to the general exhaust system. These tanks are all part of the "wet" process. The discharge from this stack is almost entirely air and water vapor.

2. Bldg. 9-Dracco Dust Collector Stack, 4th floor roof. This stack is approximately 130 ft. high. This equipment is described in Section 9B.

   During operation, once every other week, hour-long air samples are taken at the point of discharge and other areas on the roof. Most of the time the air sample results are well below 1 M.P.C. Th(nat) for unrestricted areas. On the rare occasion that the discharge shows higher radioactivity than usual corrective maintenance is done to correct the situation.

3. Bldg. 9-Water Scrub Shelf Tower, 4th floor roof. This equipment is described in Section 9B. The discharge from this tower is 120 ft. above ground level.

4. Bldg. 3-Thorium Oxide Process Oxalate Precipitation. The kettles used to dissolve damp nitrate and precipitate the oxalate are enclosed in a hood which is vented by a stack 30 ft. high. The stack discharges water vapor. (See section 9 M,N, & O.)

5. Bldg. 3-Thorium Oxalate Drier. The oxalate drier (see section 9 M,N & O) stack vents water vapor and products of natural gas combustion at a height of 30 ft. from ground level.

6. Bldg. 3-Muffle Furnace. The furnace (see section 9 M,N,&O) exhaust stack discharges CO_2 and gas combustion products at a height of 30 ft.

7. Dust Collector for ThO_2 Process - Bldg. 3. The collector stack discharges at a height of 40 ft. above ground level. Air sampling similar to that described above (2) for the dust collector stack on the 4th floor roof is performed.

8. Ore Roasting - Bldg. 4A. As described in 9A, the ore roasting equipment is serviced by a dust collector and a wet scrubber. This combination very effectively removes dust before the ventilation air is discharged from the scrubber stack which is approximately 60ft. in the air. Air samples are obtained on the roof of this building.

9. Incinerator. See Section 13 for details.

10. Shipping Warehouse Small Package Station. Occasionally we need to make small packages of thorium nitrate or oxide. The radioactive material is handled within a dust collector hood with the operator outside. The collector is a Torit Model 124 bag collector. The clean air discharged 10 ft. above ground through a wall of the building. Loading is 2800 C.F.M.

As a double check on our dust collection effectiveness we take at least six (6) air samples each month around the periphery of our plant property. Also, on a weekly basis, outside air samples are collected east and west of our plant at a distance of approximately one-half mile.

Roof top samples, fence line samples and remote samples over the past few years indicate we are not exceeding regulations covering airborne radioactivity in unrestricted areas.

15. (A description of the method for determining exposures of employees to external radiation. For film badge studies, indicate number and category of personnel involved in the program.)

A film badge program is used to determine the exposure of employees to external radiation.

All chemical operators, laborers, maintenance men, and immediate supervisors of these employees are required to use film badges. Laboratory and other personnel who either work with or frequently visit areas where radioactive material is handled or stored also are required to use film badges. Persons whose duties are not likely to involve them with radioactive material handling, and who seldom visit operating or storage areas are not required to use film badges.

Chemical operators and laborers who are considered "thorium handlers" are on a weekly badge service to minimize the possibility of over-exposure. All other personnel in the film badge program are on a monthly badge service schedule.

We currently have 30 persons on weekly badge service and 115 on monthly service. These numbers will vary depending on production manpower requirements.

At a minimum, Gamma meter surveys are conducted during the time that monthly general air samples are obtained. Records of these surveys are kept.

16. (A description of your methods for contamination control, including provisions for monitoring and the levels of contamination at which decontamination is performed.)

Our housekeeping program includes wet scrubbing of the floors daily in areas where thorium containing material is handled. In the case of a spill, the operator is instructed to clean it up as soon as practical. The level at which decontamination is necessary is that amount which is visible to the eye. A monitoring survey for surface contamination, therefore, is essentially a visual inspection. Survey meters are used to distinguish between radioactive and non-radioactive contamination.

Personal protective equipment provided for employee use when needed includes hard hats, safety glasses, chemical goggles, face shields, plastic jackets and pants, rubber safety shoes or boots, assorted glove types and styles, dust and fume respirators, and other miscellaneous equipment.

Shower and locker room facilities are available for all operating personnel. A clothes washer and dryer is also available. These people are instructed to bathe or wash thoroughly after their work shift. They are also instructed to promptly wash off any thorium material which may accidentally spill on their skin.

Approximately twenty (2) smear samples are collected and analyzed monthly to measure radioactive contamination levels in the thorium processing areas, locker and luncheon facilities. All thorium product containers are surveyed and smear tested for contamination prior to shipment.

17. (A copy of the written radiological safety operation instructions supplied to employees. These instructions should include provisions for personal hygiene, including washing prior to eating or leaving the plant, instructions for wearing personnel monitoring devices, and instructions for cleaning up dust and spills within the plant.)

See enclosed "Radioactivity Statement" and Page 18 of booklet titled, "General Safety Rules and Safe Procedures."

RADIOACTIVITY STATEMENT

General Instructions for Handling Radioactive Materials in the West Chicago Plant

Employees of Kerr-McGee Chemical Corp. are hereby informed of the occurrence of radioative materials and radiation in the West Chicago Plant.

The Corporation is required by law to explain the safety problems associated with handling radioactive materials. In a sense there are no safety problems concerning radioactivity in the plant. That is, careful observations have failed to show any employee has ever been injured by radioactive material during the nearly sixty years this plant has operated. The reason for this is that radioactivity is present at levels very low compared to those known to be harmful. The exact level at which radioactivity becomes harmful has not yet been determined. Scientists are in universal agreement that exposure of normal persons to radioactive material produces no beneficial results. Consequently, the Atomic Energy Commission (AEC) has set very low levels of radiation and of airborne concentrations of radioactive material to which persons handling licensed material such as thorium may be exposed. The Corporation provides equipment such as hoods with forced draft ventilations, dust masks, gloves, etc., and follows good housekeeping procedures such as sweep-downs and wash-downs. No employee exercising common sense should ever receive radiation in excess of the limits permitted by the AEC, or be present in concentrations or airborne radioactivity in excess of permissible limits.

By observing some simple rules, an employee can keep his exposure well below even the very low limits allowed by the AEC. The basic principle is to avoid unnecessary contact with radioactive materials, such as monazite ore or thorium concentrates. Following are some of the ways of cutting down on exposure:

1. Most Important -- Avoid any dust unnecessarily.
2. Wear a dust mask faithfully on the operations and at the times required. Your foreman will instruct you as to when to wear, how to wear, and how to care for your mask.
3. Do not make unauthorized visits to dusty operations.
4. Do not rest on monazite bags or drums of thorium or even stay next to them unnecessarily.
5. If material is accidentally spilled, clean it up as soon as practical; or if you are in doubt as to proper procedure, tell your foreman. If the material can be recovered by sweeping it up, avoid raising dust. Spilled solutions are to be hosed down. If a thorium solution or powder is accidentally spilled on your skin, wash it off before doing anything else. Other material should be washed off as soon as practical. Spilled thorium oxide powder is a special case and is to be vacuumed up, unless the amount is so large as to make this impractical. For example, if a bottle of thorium oxide should break, it would be better to carefully shovel the bulk of it up while wearing a dust mask and gloves. After vacuuming, the area is to be wet-mopped with soap and water. Discharge the used water to the waste drain.
6. When you leave your work station, wash your hands thoroughly, especially before eating.
7. Your badge measures the radiation you receive from external sources. Wear your badge faithfully. Avoid splashing material on it.

Should you ever be exposed to more radioactivity in this plant than permitted by the AEC, you and the AEC will be so informed in writing by the Corporation as required by law. Such notice will not indicate that you have been injured in any manner. If there are any over-exposures in this plant, they will be slight. Also, the AEC has stated that considerably higher exposure limits than those permitted would not result in excessive hazards. The notifications serve as checks on the efficiency of our radiation protection program. It is good common sense for you to do your part to limit your exposure and that of your fellow worker to such low levels that we never have an over-exposure.

KERR-McGEE CHEMICAL CORP.

I have read the above statement concerning radioactivity at the West Chicago Plant.

Date: ______________________ Signature: ______________________

KERR-McGEE
258 ANN STREET • WEST CHICAGO, ILLINOIS 60185

231-0760

June 13, 1972

U. S. Atomic Energy Commission
Washington, D. C. 20545

Attention: Mr. Don F. Harmon
Source and Special Nuclear Materials Branch
Division of Materials Licensing

Amend. 2

Docket No. 40-2061
License No. STA-583

Gentlemen:

Enclosed herewith is a description of procedures, in accordance with Condition 8 of the subject license, revised as of June, 1972 to reflect process and other changes made since the date of the current license application. Also enclosed is Exhibit I, Drawing No. C11083-4 revised to show additions in waste disposal facilities.

These revisions have been made at the request of the Division of Compliance, Region III, and supercede documents now in Commission files.

Please advise the undersigned should you have any questions regarding these documents.

Yours truly,

O. L. Daigle
Plant Manager

OLD/fw
Encls.
cc: Mr. Boyce H. Grier, Regional Director, USAEC

JUN 15 1972

LINDSAY RARE EARTHS

1. (A detailed description of your organization, including authority and responsibility of each level of management and/or supervision in regard to development, approval, and adherence of operating procedures.)

The authority and responsibility for developing our operating procedures is assigned to our Technical Services Department. Approvals are required by the Manager, Technical Services; Manager, Plant Engineering, Radiation Safety Officer; Manager, Production and Plant Manager. A safety committee review of the procedure is made prior to approvals. Approved procedures are subject to review and audit by the Nuclear Division Health and Safety Coordinator.

The General Foremen and line supervisors have the responsibility of assuring adherence to the operating procedures. As an aid to the supervisor, safety inspections are conducted by committees and individuals. Processes are reviewed as required by the Technical Services Department.

2. (The qualifications and experience of the personnel in your organization assigned the responsibility for developing, conducting and administering the radiation safety program for the plant.)

The responsibility for developing, conducting and administering our radiation safety program is with the Radiation Safety Officer. He has a degree in chemistry and has several years experience in the inorganic chemical field.

Reporting to the Radiation Safety Officer is a "Radiation Hygienist." This person has received formal training in health physics by completing courses in radiation detection and measurements and radioisotope chemistry at Aurora College, Aurora, Illinois.

Supervisors have a minimum of a high school education and report to chemists or chemical engineers. Supervisors receive Safety and Radiation Protection training.

The Radiation Safety Program is reviewed and audited by the Nuclear Division Health and Safety Coordinator who has eight years of varied health physics experience and an M.S. degree in Radiation Biophysics.

3. (A description of the area in which the plant is located, including the size of nearby inhabited areas, location of wells, streams and rivers, flood stage levels of streams and rivers, and sources of water supply for the plant. A topographical map with the above identification is preferred.)

A composite USGS topographical map is attached as Exhibit I. The map is made up of portions of the West Chicago and Naperville, Illinois quadrangles in which the City of West Chicago and properties of the Rare Earth Plant, Kerr-McGee Chemical Corp. lie. The extent of the latter properties and the location of municipal and Division water supply wells are delineated on a transparent overlay positioned on the map.

The Plant's physical location is on the southwest side of the City of West Chicago. Several private homes border the property on the north and east, and the Elgin, Joliet & Eastern RR borders it on the west. Other private homes are located to the west of the railroad property.

The elevation above sea level of the municipality ranges from 730 feet to 784 feet, the latter being the elevation at the West Chicago City Hall. The elevation of the Plant's property is from 750 feet at the main plant location, on the north, to slightly under 730 feet in the disposal area, on the south.

The principal streams within a five mile radius of the plant are the DuPage River (west branch) on the east and Kress Creek on the west and south. The latter flows into the DuPage about two miles south of the plant. At their closest points, the DuPage River is one mile from the Plant's disposal ponds and Kress Creek, one half mile. Both streams flow in a southerly direction.

The streams have no history of serious flooding. According to one authority (U. S. Corps of Engineers) the highest level or elevation on record for the DuPage River as measured at the gaging station at U. S. Highway 64, two miles north of the City, is 728.1 feet reached in June, 1967. There are no corresponding figures available for the DuPage at the sewage treatment plant, southeast of the City, or at its confluence with Kress Creek, but the same authority estimated that these would have been much lower.

4. (A description of the method for restricting both the plant and waste disposal area from unauthorized entry.)

The plant and waste disposal areas are surrounded by cyclone type fencing. Gates in the fence are kept locked except when in use. Employee and visitor entrance doors are open during business hours and a clerk-receptionist controls the entry of individuals. These doors are locked after business hours and only responsible persons can gain entry by using special keys issued for this purpose. Watchman tours are conducted during non-business hours. Watchclock key stations are located within the plant, out-of-doors,and in various out buildings.

5. (A description of your waste disposal procedures. Where retention systems such as levees, dikes, ponds, etc., are used to prevent the release of liquid or solid waste containing radioactive material to offsite areas, describe the retention capability and integrity of the system, conditions that might lead to accidental release of the waste, the environmental effects of such a release and your program of inspection and maintenance to prevent such accidental occurrences. This description should also include drawings showing the layout, heights, top width, side slopes, freeboard, seepage control, protection of embankment surfaces, foundation design, typical cross-sections, characteristics of fill material and a discussion of construction methods and specifications.)

Solid trash type waste which may be contaminated with thorium material is kept separate from non-contaminated refuse. Monazite ore bags and a very small amount of other combustible material are burned in an incinerator. Non-contaminated refuse and scrap, and decontaminated scrap, are removed from the premises by a scavenger service.

Prior to removal all scrap equipment which has been used in thorium processing operations is surveyed and if needed, decontaminated to levels below the limits set forth in an A.E.C. document titled "Radioactivity Contamination Limits for Abandonment of Facilities and Equipment" as follows:

RADIOACTIVITY CONTAMINATION LIMITS FOR ABANDONMENT OF FACILITIES AND EQUIPMENT

1. The maximum amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 25,000.

2. The average amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 5,000.

3. The maximum amount of removable (capable of being removed by wiping the surface with a filter paper or soft absorbent paper) alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 1,000.

4. (a) The maximum level at one centimeter from the most highly contaminated surface of a building or piece of equipment measured with an open-window beta-gamma survey meter through a tissue equivalent absorber of not more than seven milligrams per square centimeter should not exceed one millirad per hour.

   (b) The average radiation level at one centimeter from the contaminated surface of the building or equipment measured in the same manner should not exceed 0.2 millirad per hour.

5. **The contamination limits for abandonment of facilities involving U-233, or plutonium should not exceed 1/10 of the limits in items 1, 2 and 3 above.**

Solid chemical residue composed mainly of silica, unreacted monazite, zircon, rutile, calcium sulfate and barium sulfate, and other gangue is piled on the ground in our waste disposal area at the southwest corner. This material is of a very sticky, pasty nature which dries to a hard cake. It does not have a tendency to dust or dry to a powder and is extremely insoluble. This pile does emanate some radiation. Survey meter readings taken at the fence line adjacent to the pile have never exceeded 2.5 mr per hour. The areas south and west of the fence are not inhabited. Parallel to, and about 25 ft. from the west fence is a railroad right-of-way.

The radiation dosage to anyone on a passing train is negligible. Observations over a period of several years have shown that pedestrians very seldom use the railroad right-of-way. However, if it is assumed that a person makes four trips per day every day at three miles per hour along the 400 ft. of fence in question and that the dose rate is 2.5 mr/hr, the dose received would be less than 0.1 rem per year.

Pursuant to section 20.105 (a) we request allowance to produce a radiation level in the unrestricted area at the southwest boundary of our waste disposal area of not more than 2.5 mr per hour.

Attached as Exhibits II and III are Drawings C-11083-4 and B-12016. These show the Plant property in some detail, and graphically describe liquid waste disposal methods and procedures.

Inorganic liquid wastes generated in plant operations are discharged into surface trenches within the enclosed plant area. These discharge into a collecting basin or sump (Bldg. 14). Automatically operated pumps transfer the waste via underground and surface piping to a series of five settling and seepage ponds located approximately 750 feet south of the main plant area.

Pond No. 1, the largest, is used primarily for settling entrained solids and post precipitates, and receives the pumped waste directly from Bldg. 14. Clarified waste is pumped to either/or Pond Nos. 2, 3, 4 or 5 for seepage and disposal. The level in Pond No. 1 is automatically maintained by the pump, and levels in the other ponds are controlled below the established free board point by manually valving off individual transfer lines.

Surface trenches within the enclosed plan area are constructed of concrete and lined with acid brick. Trenches are generally covered.

Underground conduit, in the most part, consists of 54 inch diameter reinforced concrete pipe lined with acid brick. In transition zones and a few other areas, the conduit is rectangular and again constructed of concrete lined with brick.

The collecting basin or sump is approximately 20 feet deep and has a holding capacity of 50,000 gallons. It is constructed of reinforced concrete and lined with acid brick.

The underground transfer line from the sump (Bldg. 14) to the disposal ponds is a 6 inch rubber-lined, steel pipe. It outcrops in the vicinity of Pond No. 2 and is connected to a 6 inch reinforced rubber hose laid above ground and discharging into Pond No. 1. Similar hoses run from the pumping station on Pond No. 1 to the other ponds.

Pond construction, holding capacity and other data are as shown in Exhibit III, Drawing B-12016.

All parts of the liquid waste disposal system are well inspected and maintained. Trenches, conduit and sump are cleaned and inspected annually, and repaired as indicated. Pumps and piping are checked daily, and transfer lines and ponds are inspected at least once every 8 hour work shift. Ponds are dredged, as needed, to remove accumulated sludges.

6. (A description of the geological and hydrological characteristics which may affect the degree and mode by which liquid wastes may reach underground and/or surface waters. This should include estimates of local evaporation and seepage rates, depth of the local water table and permeability characteristics of underlying material.)

As shown on the attached Exhibits II and III and described under "No. 5," inorganic liquid wastes are essentially all disposed of in seepage ponds. Some evaporation of the ponded waste takes place but because of climate and humidity conditions it is doubtful that the amount is significant.

The ground in which the ponds are located consists of several strata of soils having varying degrees of permeability. The most permeable is the coarse sand and gravel stratum which forms the base or floor of the ponds. The uppermost or topsoil has fair to poor permeability, and the clay stratum underlying the gravel has very poor permeability. It is doubtful that much seepage takes place in either of these strata.

Seepage rates vary from 0.2 to 0.5 gal/sq.ft/hour. These appear to be low, considering the permeability of the gravel, but sludge settled in Pond No. 1 or small amounts that may be carried over into the other ponds impede outflow to some degree. Ground water levels also affect seepage. The current ground water elevation, as reported by the Illinois State Water Survey, averaged 726 feet in the West Chicago area. This will vary according to seasons and will be lowest in the fall and highest in the spring of the year.

7. (A description of the liquid effluent survey program (assuming plant effluents reach subterranean or surface water supplies), including the number, location and frequency of check samples and procedures for the sample analysis of natural thorium and radium-228.)

Liquid effluent samples are obtained daily. A one quart grab sample is obtained from the overflow hose which drains the settling pond (Pond #1). The sample is taken at the discharge end of the hose immediately before it enters the seepage pond (Pond #2). The seven samples per week are composited into a weekly sample.

The composite sample is allowed to stand until the very little amount of solids settle to the bottom of the jar. A 1 ml sample of the clear liquid is evaporated in a 1.25 inch stainless steel planchet for alpha counting. This sample contains the soluble radioactive material, if any.

The composite sample is then thoroughly stirred, suspending the solids. While stirring, a 1 ml sample is taken and dried in a planchet. This sample contains the soluble and insoluble radioactive material, if any.

The samples are alpha counted (windowless) for 1 hour. A one hour background is counted immediately before each sample, and another background is counted after each sample. Assuming the before and after background counts are reasonably the same, the average background count is determined and deducted from the sample count. Should the before and after background counts not reasonably agree the counting is repeated.

The corrected counts of the sample "soluble only" is deducted from the corrected counts of the sample "soluble and insoluble" the difference being considered to be "insoluble only."

Aged thorium nitrate is dissolved in water to a concentration of 10^{-6} μci/ml. One ml of this solution is dried in a planchet. One hour before and after backgrounds are alpha counted with the thorium reference sample between.

The water sample counting data is corrected for background and divided by the corrected reference sample counts. Results are reported as μci/ml thorium (nat.).

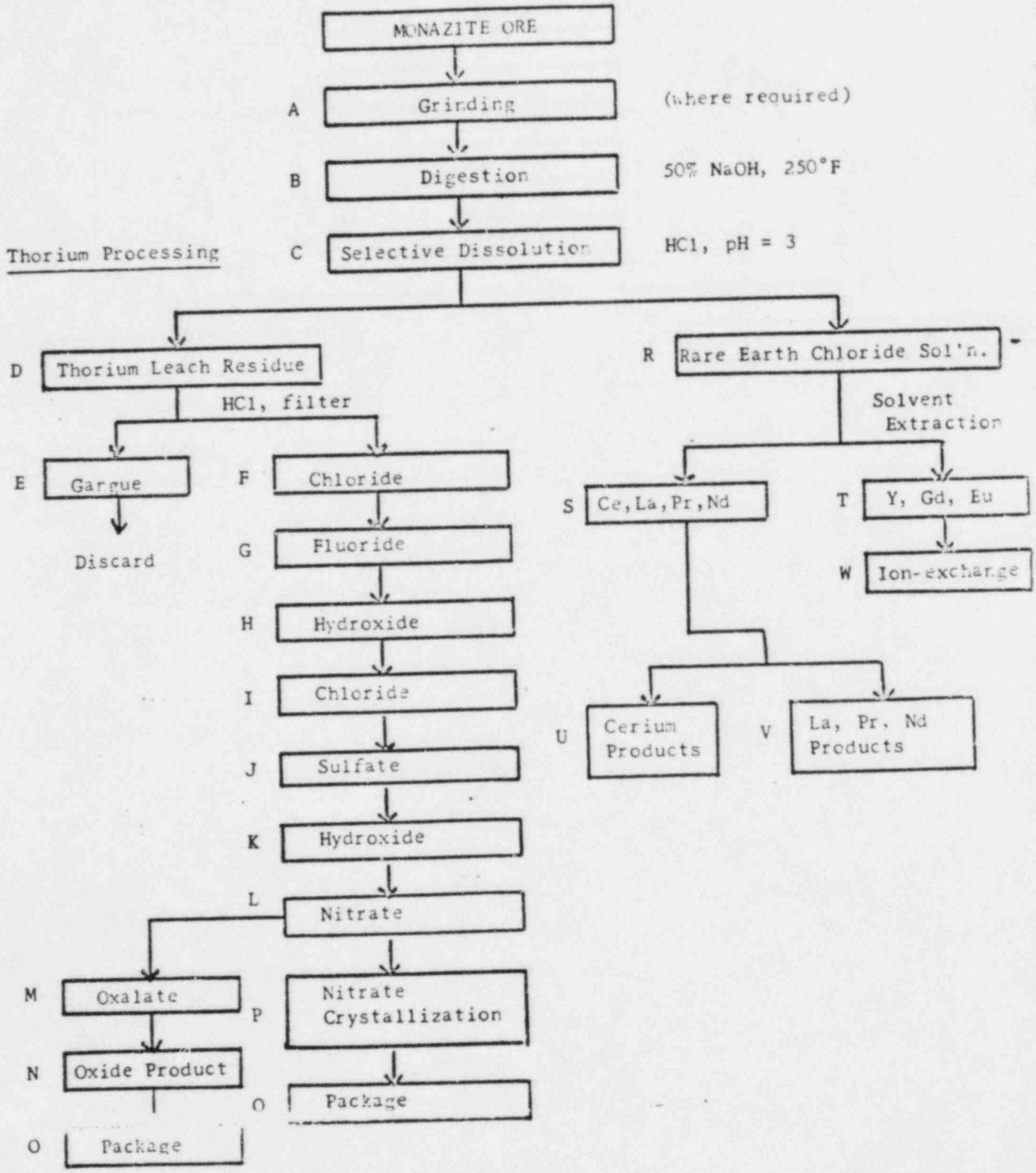
For a period of over a year during 1967 and 1968, waste effluent was radio assayed on a daily basis. Of 475 daily samples assayed for soluble radioactivity 306 were reported as N.D. and the average concentration was 0.12×10^{-6} µci/ml. The insoluble portion was assayed as well. 285 of the samples for insoluble radiation were N.D. and the average concentration was 0.36×10^{-6} µci/ml.

Most N.D. results reported are equal or nearly equal to background. Results less than 10^{-7} µc/ml are also reported as N.D.

Additional environmental water samples are collected monthly from the plant storm sewer system and nearest river. These samples are analyzed by the described procedure for thorium and to date there is no evidence of thorium contamination in these streams.

8. (A flow diagram of the plant production operation a diagram of the plant layout, indicating areas and points in the process where dust is generated).

The process essentially is the caustic digestion method for extracting rare earth and thorium values from monazite ore.



9. (A description of dust collection and ventilation equipment that are utilized during plant operation, including type, capacity and location of such equipment, eg., ore transfer points, crushing, grinding, etc., and an analysis of the efficiency of the equipment as designed to control or prevent the release of airborne radioactivity to the environs.)

Dust collection equipment is indicated on the floor plans by a star (*). The star indicates the point of operation where airborne radioactivity is generated and thence collected.

A. Ore may or may not be ground, depending on quality. The grinding operation is provided with ventilation control and dust collecting equipment which prevents airborne radioactivity exposure in excess of CFR-20 limits for the operator or operators who attend the operation and for unrestricted areas.

   Ore is not ordinarily roasted, although equipment is available for this. (See floor plan titled "Sand Roasting Shed-Bldg. 4A.") A Dracco 52 bag collector and a Schneible Multiwash Scrubber are located on the roof of Building 4A. Dust laden air is filtered through the bag collector. The filtered air then passes through the scrubber and the dust free air is then discharged to the atmosphere. The system loading is approximately 12,500 C.F.M. The air relocities at the various hoods (*) have a minimum of 125 F.P.M. Capture velocity is approximately 100 F.P.M. During past operations several hundred air samplings have been taken resulting in no overexposures for any of our personnel.

B. Ore is placed into a Monazite sand hopper (see floor plan titled "Bldg. 9 1st Floor area"). The ore is lifted to the 4th floor by a bucket elevator. The sand hopper is hooded and ducted to a Dracco 3-compartment No. 40 bag collector which is located on the 4th floor roof.

The elevated ore is discharged into a surge bin. (See floor plan "Bldg. 9 Fourth Floor Equipment Layout.") The surge bin discharged into charging buckets positioned on a weighing scale. This operation is enclosed in a hood ducted to the dust collector.

Air velocities at the face of the hoods are:

1.	1st Floor Sand Hopper Hood	135 F.P.M.
2.	4th Floor Weighing Station	110 F.P.M.

Capture velocity is approximately 75-100 F.P.M., and the system loading is approximately 8,000 C.F.M.

Hundreds of air samplings have shown no excessive exposures to airborne radioactivity for our personnel working at the sand hopper or weighing station.

The charging buckets are emptied into reaction pots containing hot liquid caustic soda. Vapors and gases from the reaction are exhausted from the pots, and scrubbed in wet scrubbers before discharge to the atmosphere.

From this point through many process steps there is no significant airborne radioactivity problem.

J. (Flow diagram Step J - Thorium Sulfate)

Thorium sulfate is slowly crystallized from a thorium chloride solution usi g mild air agitation and a lightening stirrer. Water vapor containing a small amount of hydrochloric acid is evolved. This vapor is passed through a packed, wet caustic scrubber and exhausted into an 80' high general purpose exhaust stack. (See floor plan "Bldg. 9, 3rd Floor Layout."

L. (Flow diagram Step L - Thorium Nitrate)

This part of the process is serviced by a scrubber. (See floor plan "Bldg. 9, 2nd Floor Equipment Layout.")

Thorium nitrate feed solution is evaporated in kettles to concentrate the solution. Upon cooling, crystals of thorium nitrate are formed. During the evaporation water vapor containing oxides of nitrogen are evolved. The kettles are completely enclosed in a hood which is ventilated to a packed tower scrubber with a caustic scrub to remove the small amount of nitrogen oxides. The scrubber discharges into the general process exhaust system.

The scrubber loading is 4300 C.F.M. and air velocities measured at the opened inspection door in the hood panel are greater than 200 F.P.M.

M,N,O. (Flow diagram Steps M, N, & O - Thorium Oxide)

(See floor plan "Thorium Oxide Rooms - Bldg. 3.")

Damp thorium nitrate crystals are dissolved in water and oxalic acid added to precipitate thorium oxalate. This slurry is filtered and the damp cake is spread on trays and dried in a tray drier. The water vapor is vented directly to the atmosphere.

The trays of dried oxalate are placed under a hood and the product is scooped into ceramic ignition saggers. The saggers are placed into a muffle furnace where the oxide is formed. A slot hood shroud is fixed around the furnace door to remove dust which may occur during loading and unloading the furnace.

After ignition and cooling the saggers are dumped into a blending drum. A slot hood removes dust generated when dumping. After blending, the blending drum outlet valve is alternately opened and closed to fill the final package. A dust vent removes dust during packaging.

The various hoods and vents used in these operations are ducted to a Brady Dust Filter Model 1375.

The air velocities at the face of the various hoods are as follows:

Dried Oxalate Hood	300 FPM
Furnace Slot Hood	300 FPM
Saggers Dumping Hood	130 FPM
Packaging Dust Vent	Above 300 FPM

System loading is approximately 6100 CFM.

The Brady dust filter collector is located 60 yards north of the Building 3 thorium oxide room. It is contained in a separate room as shown on the drawing titled "Bldg. #1 Floor Equipment Layout."

10. & 11. (A description of the survey program which is followed to determine concentrations of airborne radioactivity within the plant, including the make, model number and capacity of sampling devices, and your procedure for sample analysis. Include a description of:
   a. Each sampling location in respect to operating personnel.
   b. Each sampling location in respect to process operation.
   c. The frequency (for a & b).
   d. Surveys made during maintenance operations.)

Concentrations of airborne radioactivity within the plant are determined for the following:

A. Breathing zone of the operator while at the point of operation where dusty radioactive material is handled. (5 minute air sample)

B. Specific work area the operator occupies when not at the point of operation. (1 hour air sample)

C. General plant areas which the operator or others may occasionally or frequently occupy. (1 hour air sample)

D. During maintenance of thorium processing equipment containing dusty material.

Many of the operations are quite intermittent. Air samplings are not taken at the point of operation during down time. General air samples are obtained, however, in each building and on each building floor which contains thorium operations, unless these areas are shut down and only rarely occupied. A general air sampling is also made in a non-thorium operating area for "background" information. General air samples are taken monthly.

Breathing zone, point of operation air samples are indicated by solid circles on the attached floor plans. These samples are taken at one-half of the points shown every other week in such a manner that a sample is taken at each point once each four weeks, except at those points where no operations are conducted during the four week period.

A specific work area sample is taken whenever a breathing zone sample is found to contain more than 3×10^{-11} µc/ml natural Th, 7×10^{-10} µc/ml Ra224, 1×10^{-7} µc/ml Bi212, or 3×10^{-7} µc/ml Rn220. Under these circumstances the operators time in the various areas he occupies is documented, and his potential 40 hour exposure calculated.

Upon learning that maintenance work is needed on equipment containing radioactive material an assessment is made of the particular job in question. If it is determined that a potential airborne contamination problem could exist then an air sampling program is established after all efforts are made to minimize the problem.

We have three air sampling devices which were designed and constructed by our personnel. Each sampler has a timer, an air pump, flow meter, air flow adjustment, and a filter paper holder. The air flow meter is calibrated using a gas meter. The air sampler is set to draw 35 liters of air per minute through a Whatman No. 41 paper which is 1.25 inch in diameter.

We use a gas flow proportional alpha counter in the "windowless" position to analyze our air samples.

Alpha counting is done as follows:

I. In cases where daughter activity is <u>more</u> than negligible and at any new point of operation, the standard formula for computing activity is:

$$\mu Ci/ml = C/M \times d/c \times 1/T \times 1/V \times 1/0.7 \times 1/K$$

Where C/M = counts per minute from the sample.

d/c = disintegrations per count (from alpha standard source)

T = Sampling time (minutes)

V = Volume sampled (= 35,000 ml)

1/0.7 = Filter paper absorption factor

and K = factor for converting d/m to μ Ci (= 2.22×10^6)

A. The sample is counted 1 hour after sampling and the gross activity calculated using the standard formula. At this point in time the Rn220 has died off and most of the alpha count is due to Bi212.

B. The sample is counted again 10.6 hours after sampling. This is a half-life of Pb212 and half of the Bi212 is also gone. Both of these at this point are the result of half of the Rn220 originally present.

1. The standard formula times 2 = Rn220 activity.

2. To obtain the Bi212 activity the standard formula calculation is multiplied by 0.9. This product is subtracted from the gross activity found in A, and the difference is multiplied by 2.

C. The sample is counted again 106 hours after sampling.

This is 10 half-lives of Pb212 and all of the short lived daughters originally present are gone.

The standard formula is calculated and divided by 1.7 = Ra224 activity.

D. The sample is counted again 465 hours after the sample was taken. At this point an apparent equilibrium has been established and we have nearly 6 alpha activity which is close to the amount at secular equilibrium.

$$\text{Th(nat)activity} = \frac{\text{Standard formula} - .1\ \text{Ra224 activity}}{5.9}$$

II. In cases where daughter activity is negligible counting is done 106 hours after the sample was taken.

The standard formula is divided by 6 to obtain the Th(nat) activity.

III. Each day the alpha standard is counted to assure that the counter is reliable.

Sample and background counts are properly taken to assure a 95% confidence level. We should detect a minimum of $9\times10^{-11}\ \mu c/ml$ Rn220 and/or Bi212. For Th(nat) we should detect $2 \times 10^{-12}\ \mu c/ml$, and for Ra224 $7 \times 10^{-11}\ \mu c/ml$. This applies to a 5 minute sample time. An hour sample would show at least 10 times greater sensitivity.

12. (A description of the procedure followed in determining the average daily and weekly exposures to airborne radioactivity for each employee who frequently or occasionally occupies areas where air contamination exceeds M.P.C. values specified in 10 CFR 20.)

We are not now using any operation which continuously causes an airborne concentration in excess of $3 \times 10^{-11}\ \mu c/ml$ of natural thorium in a restricted area during a 40 hour work week outside of ventilation control equipment.

There are a few operations which may for short periods of time exceed 3×10^{-11} µc/ml of natural thorium in the air at the point of operation. Thus there is a possibility that on a 40 hour basis an airborne concentration greater than 1 M.P.C. might exist.

Whenever a 5 minute operators breathing zone sample shows greater than 3×10^{-11} µc/ml of natural Th the operators time at the point of operation is calculated. A 1 hour air sample is taken in the environs of the area where the operator spends most of his time. The time weighted exposure including the breathing zone sample and general air sample is calculated. If the calculations show that an average of 1 M.P.C. could be exceeded during a 40 hour work week then immediate steps are taken to correct the problem. If ventilation control equipment is found deficient it is repaired. If the operators handling methods are improper he is re-instructed. As a last resort employee rotation may be used.

It is extremely rare that a general area air sample exceeds 1 M.P.C. and these operating areas are occupied so little by personnel, other than the operator, that we do not propose to document the time of an occasional occupant.

13. (If treatment or disposal of licensed material by incineration is anticipated, an application should be made in accordance with 10CFR20 sec. 20.305.)

In conformance with 10CFR20.305 we request that our license include a provision enabling us to incinerate monazite ore bags and other combustible trash.

We use a hand fed Model Co-200 incinerator equipped with a gas after burner built by the C.O. Hendrikson Company. The following data applies:

a. Trash burning capacity of incinerator - 200 lbs/hr.
b. Exhaust gas volume in stack corrected to $70^{\circ}F$ - 300 C.F.M.
c. Stack height - 30 ft.
d. Particulate emission-0.17 grains per standard cubic foot.
e. Expected maximum operating time - 10 hrs/wk.

f. Micro curies (Th(nat) of exhaust gas within stack - 8×10^{-12} μc/ml (corrected to $70^{o}F$).
g. Expected yearly average concentration of Th(nat) within stack gas - 0.46 M.P.C. (Background neglected).
h. Ash & residue (monazite sand) - 20% of trash weight.
i. Thorium content of ash & residue - 6% (1.2% of trash weight).

Before incineration the operator cleans out the ash from the previous days burning. The ash & residue is placed in boxes or drums and stored for possible future reclaiming of values.

Twice monthly, an hour-long air sampling in the general operator work area is made and the exhaust stack is sampled for radioactivity in the particulate emission.

14. (A description of plant discharge stacks including stack heights, types and concentrations of effluents discharged, method for controlling release of radioactive material, and methods for determining the concentration of radioactive material released to the environs.)

We have a total of 10 stacks which service our thorium operations. These are:

1. Bldg. 9-General purpose process exhaust system, 3rd floor roof. This stack is 80 ft. from ground level. Many processing tanks are connected to the general exhaust system. These tanks are all part of the "wet" process. The discharge from this stack is almost entirely air and water vapor.

2. Bldg. 9-Dracco Dust Collector Stack, 4th floor roof. This stack is approximately 130 ft. high. This equipment is described in Section 9B.

   During operation, once every other week, hour-long air samples are taken at the point of discharge and other areas on the roof. Most of the time the air sample results are well below 1 M.P.C. Th(nat) for unrestricted areas. On the rare occasion that the discharge shows higher radioactivity than usual corrective maintenance is done to correct the situation.

3. Bldg. 9-Water Scrub Shelf Tower, 4th floor roof. This equipment is described in Section 9B. The discharge from this tower is 120 ft. above ground level.

4. Bldg. 3-Thorium Oxide Process Oxalate Precipitation. The kettles used to dissolve damp nitrate and precipitate the oxalate are enclosed in a hood which is vented by a stack 30 ft. high. The stack discharges water vapor. (See section 9 M,N, & O.)

5. Bldg. 3-Thorium Oxalate Drier. The oxalate drier (see section 9 M,N & O) stack vents water vapor and products of natural gas combustion at a height of 30 ft. from ground level.

6. Bldg. 3-Muffle Furnace. The furnace (see section 9 M,N,&O) exhaust stack discharges CO_2 and gas combustion products at a height of 30 ft.

7. Dust Collector for ThO_2 Process - Bldg. 3. The collector stack discharges at a height of 40 ft. above ground level. Air sampling similar to that described above (2) for the dust collector stack on the 4th floor roof is performed.

8. Ore Roasting - Bldg. 4A. As described in 9A, the ore roasting equipment is serviced by a dust collector and a wet scrubber. This combination very effectively removes dust before the ventilation air is discharged from the scrubber stack which is approximately 60ft. in the air. Air samples are obtained on the roof of this building.

9. Incinerator. See Section 13 for details.

10. Shipping Warehouse Small Package Station. Occasionally we need to make small packages of thorium nitrate or oxide. The radioactive material is handled within a dust collector hood with the operator outside. The collector is a Torit Model 124 bag collector. The clean air discharged 10 ft. above ground through a wall of the building. Loading is 2800 C.F.M.

As a double check on our dust collection effectiveness we take at least six (6) air samples each month around the periphery of our plant property. Also, on a weekly basis, outside air samples are collected east and west of our plant at a distance of approximately one-half mile.

Roof top samples, fence line samples and remote samples over the past few years indicate we are not exceeding regulations covering airborne radioactivity in unrestricted areas.

15. (A description of the method for determining exposures of employees to external radiation. For film badge studies, indicate number and category of personnel involved in the program.)

A film badge program is used to determine the exposure of employees to external radiation.

All chemical operators, laborers, maintenance men, and immediate supervisors of these employees are required to use film badges. Laboratory and other personnel who either work with or frequently visit areas where radioactive material is handled or stored also are required to use film badges. Persons whose duties are not likely to involve them with radioactive material handling, and who seldom visit operating or storage areas are not required to use film badges.

Chemical operators and laborers who are considered "thorium handlers" are on a weekly badge service to minimize the possibility of over-exposure. All other personnel in the film badge program are on a monthly badge service schedule.

We currently have 30 persons on weekly badge service and 115 on monthly service. These numbers will vary depending on production manpower requirements.

At a minimum, Gamma meter surveys are conducted during the time that monthly general air samples are obtained. Records of these surveys are kept.

16. (A description of your methods for contamination control, including provisions for monitoring and the levels of contamination at which decontamination is performed.)

Our housekeeping program includes wet scrubbing of the floors daily in areas where thorium containing material is handled. In the case of a spill, the operator is instructed to clean it up as soon as practical. The level at which decontamination is necessary is that amount which is visible to the eye. A monitoring survey for surface contamination, therefore, is essentially a visual inspection. Survey meters are used to distinguish between radioactive and non-radioactive contamination.

Personal protective equipment provided for employee use when needed includes hard hats, safety glasses, chemical goggles, face shields, plastic jackets and pants, rubber safety shoes or boots, assorted glove types and styles, dust and fume respirators, and other miscellaneous equipment.

Shower and locker room facilities are available for all operating personnel. A clothes washer and dryer is also available. These people are instructed to bathe or wash thoroughly after their work shift. They are also instructed to promptly wash off any thorium material which may accidentally spill on their skin.

Approximately twenty (2) smear samples are collected and analyzed monthly to measure radioactive contamination levels in the thorium processing areas, locker and luncheon facilities. All thorium product containers are surveyed and smear tested for contamination prior to shipment.

17. (A copy of the written radiological safety operation instructions supplied to employees. These instructions should include provisions for personal hygiene, including washing prior to eating or leaving the plant, instructions for wearing personnel monitoring devices, and instructions for cleaning up dust and spills within the plant.)

See enclosed "Radioactivity Statement" and Page 18 of booklet titled, "General Safety Rules and Safe Procedures."

RADIOACTIVITY STATEMENT

General Instructions for Handling Radioactive Materials in the West Chicago Plant

Employees of Kerr-McGee Chemical Corp. are hereby informed of the occurrence of radioative materials and radiation in the West Chicago Plant.

The Corporation is required by law to explain the safety problems associated with handling radioactive materials. In a sense there are no safety problems concerning radioactivity in the plant. That is, careful observations have failed to show any employee has ever been injured by radioactive material during the nearly sixty years this plant has operated. The reason for this is that radioactivity is present at levels very low compared to those known to be harmful. The exact level at which radioactivity becomes harmful has not yet been determined. Scientists are in universal agreement that exposure of normal persons to radioactive material produces no beneficial results. Consequently, the Atomic Energy Commission (AEC) has set very low levels of radiation and of airborne concentrations of radioactive material to which persons handling licensed material such as thorium may be exposed. The Corporation provides equipment such as hoods with forced draft ventilations, dust masks, gloves, etc., and follows good housekeeping procedures such as sweep-downs and wash-downs. No employee exercising common sense should ever receive radiation in excess of the limits permitted by the AEC, or be present in concentrations or airborne radioactivity in excess of permissible limits.

By observing some simple rules, an employee can keep his exposure well below even the very low limits allowed by the AEC. The basic principle is to avoid unnecessary contact with radioactive materials, such as monazite ore or thorium concentrates. Following are some of the ways of cutting down on exposure:

1. Most Important -- Avoid any dust unnecessarily.
2. Wear a dust mask faithfully on the operations and at the times required. Your foreman will instruct you as to when to wear, how to wear, and how to care for your mask.
3. Do not make unauthorized visits to dusty operations.
4. Do not rest on monazite bags or drums of thorium or even stay next to them unnecessarily.
5. If material is accidentally spilled, clean it up as soon as practical; or if you are in doubt as to proper procedure, tell your foreman. If the material can be recovered by sweeping it up, avoid raising dust. Spilled solutions are to be hosed down. If a thorium solution or powder is accidentally spilled on your skin, wash it off before doing anything else. Other material should be washed off as soon as practical. Spilled thorium oxide powder is a special case and is to be vacuumed up, unless the amount is so large as to make this impractical. For example, if a bottle of thorium oxide should break, it would be better to carefully shovel the bulk of it up while wearing a dust mask and gloves. After vacuuming, the area is to be wet-mopped with soap and water. Discharge the used water to the waste drain.
6. When you leave your work station, wash your hands thoroughly, especially before eating.
7. Your badge measures the radiation you receive from external sources. Wear your badge faithfully. Avoid splashing material on it.

Should you ever be exposed to more radioactivity in this plant than permitted by the AEC, you and the AEC will be so informed in writing by the Corporation as required by law. Such notice will not indicate that you have been injured in any manner. If there are any over-exposures in this plant, they will be slight. Also, the AEC has stated that considerably higher exposure limits than those permitted would not result in excessive hazards. The notifications serve as checks on the efficiency of our radiation protection program. It is good common sense for you to do your part to limit your exposure and that of your fellow worker to such low levels that we never have an over-exposure.

KERR-McGEE CHEMICAL CORP.

I have read the above statement concerning radioactivity at the West Chicago Plant.

Date: ____________________ Signature: ____________________

KERR-McGEE
258 ANN STREET • WEST CHICAGO, ILLINOIS 60185

231-0767

June 13, 1972

U. S. Atomic Energy Commission
Washington, D. C. 20545

Attention: Mr. Don F. Harmon
Source and Special Nuclear Materials Branch
Division of Materials Licensing

Amend. 2

Docket No. 40-2061
License No. STA-583

Gentlemen:

Enclosed herewith is a description of procedures, in accordance with Condition 8 of the subject license, revised as of June, 1972 to reflect process and other changes made since the date of the current license application. Also enclosed is Exhibit I, Drawing No. C11083-4 revised to show additions in waste disposal facilities.

These revisions have been made at the request of the Division of Compliance, Region III, and supercede documents now in Commission files.

Please advise the undersigned should you have any questions regarding these documents.

Yours truly,

O. L. Daigle
Plant Manager

OLD/fw
Encls.
cc: Mr. Boyce H. Grier, Regional Director, USAEC

JUN 15 1972

LINDSAY RARE EARTHS

25

1. (A detailed description of your organization, including authority and responsibility of each level of management and/or supervision in regard to development, approval, and adherence of operating procedures.)

The authority and responsibility for developing our operating procedures is assigned to our Technical Services Department. Approvals are required by the Manager, Technical Services; Manager, Plant Engineering, Radiation Safety Officer; Manager, Production and Plant Manager. A safety committee review of the procedure is made prior to approvals. Approved procedures are subject to review and audit by the Nuclear Division Health and Safety Coordinator.

The General Foremen and line supervisors have the responsibility of assuring adherence to the operating procedures. As an aid to the supervisor, safety inspections are conducted by committees and individuals. Processes are reviewed as required by the Technical Services Department.

2. (The qualifications and experience of the personnel in your organization assigned the responsibility for developing, conducting and administering the radiation safety program for the plant.)

The responsibility for developing, conducting and administering our radiation safety program is with the Radiation Safety Officer. He has a degree in chemistry and has several years experience in the inorganic chemical field.

Reporting to the Radiation Safety Officer is a "Radiation Hygienist." This person has received formal training in health physics by completing courses in radiation detection and measurements and radioisotope chemistry at Aurora College, Aurora, Illinois.

Supervisors have a minimum of a high school education and report to chemists or chemical engineers. Supervisors receive Safety and Radiation Protection training.

The Radiation Safety Program is reviewed and audited by the Nuclear Division Health and Safety Coordinator who has eight years of varied health physics experience and an M.S. degree in Radiation Biophysics.

3. (A description of the area in which the plant is located, including the size of nearby inhabited areas, location of wells, streams and rivers, flood stage levels of streams and rivers, and sources of water supply for the plant. A topographical map with the above identification is preferred.)

A composite USGS topographical map is attached as Exhibit I. The map is made up of portions of the West Chicago and Naperville, Illinois quadrangles in which the City of West Chicago and properties of the Rare Earth Plant, Kerr-McGee Chemical Corp. lie. The extent of the latter properties and the location of municipal and Division water supply wells are delineated on a transparent overlay positioned on the map.

The Plant's physical location is on the southwest side of the City of West Chicago. Several private homes border the property on the north and east, and the Elgin, Joliet & Eastern RR borders it on the west. Other private homes are located to the west of the railroad property.

The elevation above sea level of the municipality ranges from 730 feet to 784 feet, the latter being the elevation at the West Chicago City Hall. The elevation of the Plant's property is from 750 feet at the main plant location, on the north, to slightly under 730 feet in the disposal area, on the south.

The principal streams within a five mile radius of the plant are the DuPage River (west branch) on the east and Kress Creek on the west and south. The latter flows into the DuPage about two miles south of the plant. At their closest points, the DuPage River is one mile from the Plant's disposal ponds and Kress Creek, one half mile. Both streams flow in a southerly direction.

The streams have no history of serious flooding. According to one authority (U. S. Corps of Engineers) the highest level or elevation on record for the DuPage River as measured at the gaging station at U. S. Highway 64, two miles north of the City, is 728.1 feet reached in June, 1967. There are no corresponding figures available for the DuPage at the sewage treatment plant, southeast of the City, or at its confluence with Kress Creek, but the same authority estimated that these would have been much lower.

4. (A description of the method for restricting both the plant and waste disposal area from unauthorized entry.)

The plant and waste disposal areas are surrounded by cyclone type fencing. Gates in the fence are kept locked except when in use. Employee and visitor entrance doors are open during business hours and a clerk-receptionist controls the entry of individuals. These doors are locked after business hours and only responsible persons can gain entry by using special keys issued for this purpose. Watchman tours are conducted during non-business hours. Watchclock key stations are located within the plant, out-of-doors, and in various out buildings.

5. (A description of your waste disposal procedures. Where retention systems such as levees, dikes, ponds, etc., are used to prevent the release of liquid or solid waste containing radioactive material to offsite areas, describe the retention capability and integrity of the system, conditions that might lead to accidental release of the waste, the environmental effects of such a release and your program of inspection and maintenance to prevent such accidental occurrences. This description should also include drawings showing the layout, heights, top width, side slopes, freeboard, seepage control, protection of embankment surfaces, foundation design, typical cross-sections, characteristics of fill material and a discussion of construction methods and specifications.)

Solid trash type waste which may be contaminated with thorium material is kept separate from non-contaminated refuse. Monazite ore bags and a very small amount of other combustible material are burned in an incinerator. Non-contaminated refuse and scrap, and decontaminated scrap, are removed from the premises by a scavenger service.

Prior to removal all scrap equipment which has been used in thorium processing operations is surveyed and if needed, decontaminated to levels below the limits set forth in an A.E.C. document titled "Radioactivity Contamination Limits for Abandonment of Facilities and Equipment" as follows:

RADIOACTIVITY CONTAMINATION LIMITS FOR ABANDONMENT OF FACILITIES AND EQUIPMENT

1. The maximum amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 25,000.

2. The average amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 5,000.

3. The maximum amount of removable (capable of being removed by wiping the surface with a filter paper or soft absorbent paper) alpha radioactivity in disintegrations per minute per 100 square centimeters on buildings or equipment should not exceed 1,000.

4. (a) The maximum level at one centimeter from the most highly contaminated surface of a building or piece of equipment measured with an open-window beta-gamma survey meter through a tissue equivalent absorber of not more than seven milligrams per square centimeter should not exceed one millirad per hour.

   (b) The average radiation level at one centimeter from the contaminated surface of the building or equipment measured in the same manner should not exceed 0.2 millirad per hour.

5. The contamination limits for abandonment of facilities involving U-233, or plutonium should not exceed 1/10 of the limits in items 1, 2 and 3 above.

Solid chemical residue composed mainly of silica, unreacted monazite, zircon, rutile, calcium sulfate and barium sulfate, and other gangue is piled on the ground in our waste disposal area at the southwest corner. This material is of a very sticky, pasty nature which dries to a hard cake. It does not have a tendency to dust or dry to a powder and is extremely insoluble. This pile does emanate some radiation. Survey meter readings taken at the fence line adjacent to the pile have never exceeded 2.5 mr per hour. The areas south and west of the fence are not inhabited. Parallel to, and about 25 ft. from the west fence is a railroad right-of-way.

The radiation dosage to anyone on a passing train is negligible. Observations over a period of several years have shown that pedestrians very seldom use the railroad right-of-way. However, if it is assumed that a person makes four trips per day every day at three miles per hour along the 400 ft. of fence in question and that the dose rate is 2.5 mr/hr, the dose received would be less than 0.1 rem per year.

Pursuant to section 20.105 (a) we request allowance to produce a radiation level in the unrestricted area at the southwest boundary of our waste disposal area of not more than 2.5 mr per hour.

Attached as Exhibits II and III are Drawings C-11083-4 and B-12016. These show the Plant property in some detail, and graphically describe liquid waste disposal methods and procedures.

Inorganic liquid wastes generated in plant operations are discharged into surface trenches within the enclosed plant area. These discharge into a collecting basin or sump (Bldg. 14). Automatically operated pumps transfer the waste via underground and surface piping to a series of five settling and seepage ponds located approximately 750 feet south of the main plant area.

Pond No. 1, the largest, is used primarily for settling entrained solids and post precipitates, and receives the pumped waste directly from Bldg. 14. Clarified waste is pumped to either/or Pond Nos. 2, 3, 4 or 5 for seepage and disposal. The level in Pond No. 1 is automatically maintained by the pump, and levels in the other ponds are controlled below the established free board point by manually valving off individual transfer lines.

Surface trenches within the enclosed plan area are constructed of concrete and lined with acid brick. Trenches are generally covered.

Underground conduit, in the most part, consists of 54 inch diameter reinforced concrete pipe lined with acid brick. In transition zones and a few other areas, the conduit is rectangular and again constructed of concrete lined with brick.

The collecting basin or sump is approximately 20 feet deep and has a holding capacity of 50,000 gallons. It is constructed of reinforced concrete and lined with acid brick.

The underground transfer line from the sump (Bldg. 14) to the disposal ponds is a 6 inch rubber-lined, steel pipe. It outcrops in the vicinity of Pond No. 2 and is connected to a 6 inch reinforced rubber hose laid above ground and discharging into Pond No. 1. Similar hoses run from the pumping station on Pond No. 1 to the other ponds.

Pond construction, holding capacity and other data are as shown in Exhibit III, Drawing B-12016.

All parts of the liquid waste disposal system are well inspected and maintained. Trenches, conduit and sump are cleaned and inspected annually, and repaired as indicated. Pumps and piping are checked daily, and transfer lines and ponds are inspected at least once every 8 hour work shift. Ponds are dredged, as needed, to remove accumulated sludges.

6. (A description of the geological and hydrological characteristics which may affect the degree and mode by which liquid wastes may reach underground and/or surface waters. This should include estimates of local evaporation and seepage rates, depth of the local water table and permeability characteristics of underlying material.)

   As shown on the attached Exhibits II and III and described under "No. 5," inorganic liquid wastes are essentially all disposed of in seepage ponds. Some evaporation of the ponded waste takes place but because of climate and humidity conditions it is doubtful that the amount is significant.

   The ground in which the ponds are located consists of several strata of soils having varying degrees of permeability. The most permeable is the coarse sand and gravel stratum which forms the base or floor of the ponds. The uppermost or topsoil has fair to poor permeability, and the clay stratum underlying the gravel has very poor permeability. It is doubtful that much seepage takes place in either of these strata.

   Seepage rates vary from 0.2 to 0.5 gal/sq.ft/hour. These appear to be low, considering the permeability of the gravel, but sludge settled in Pond No. 1 or small amounts that may be carried over into the other ponds impede outflow to some degree. Ground water levels also affect seepage. The current ground water elevation, as reported by the Illinois State Water Survey, averaged 726 feet in the West Chicago area. This will vary according to seasons and will be lowest in the fall and highest in the spring of the year.

7. (A description of the liquid effluent survey program (assuming plant effluents reach subterranean or surface water supplies), including the number, location and frequency of check samples and procedures for the sample analysis of natural thorium and radium-228.)

Liquid effluent samples are obtained daily. A one quart grab sample is obtained from the overflow hose which drains the settling pond (Pond #1). The sample is taken at the discharge end of the hose immediately before it enters the seepage pond (Pond #2). The seven samples per week are composited into a weekly sample.

The composite sample is allowed to stand until the very little amount of solids settle to the bottom of the jar. A 1 ml sample of the clear liquid is evaporated in a 1.25 inch stainless steel planchet for alpha counting. This sample contains the soluble radioactive material, if any.

The composite sample is then thoroughly stirred, suspending the solids. While stirring, a 1 ml sample is taken and dried in a planchet. This sample contains the soluble and insoluble radioactive material, if any.

The samples are alpha counted (windowless) for 1 hour. A one hour background is counted immediately before each sample, and another background is counted after each sample. Assuming the before and after background counts are reasonably the same, the average background count is determined and deducted from the sample count. Should the before and after background counts not reasonably agree the counting is repeated.

The corrected counts of the sample "soluble only" is deducted from the corrected counts of the sample "soluble and insoluble" the difference being considered to be "insoluble only."

Aged thorium nitrate is dissolved in water to a concentration of 10^{-6} μci/ml. One ml of this solution is dried in a planchet. One hour before and after backgrounds are alpha counted with the thorium reference sample between.

The water sample counting data is corrected for background and divided by the corrected reference sample counts. Results are reported as μci/ml thorium (nat.).

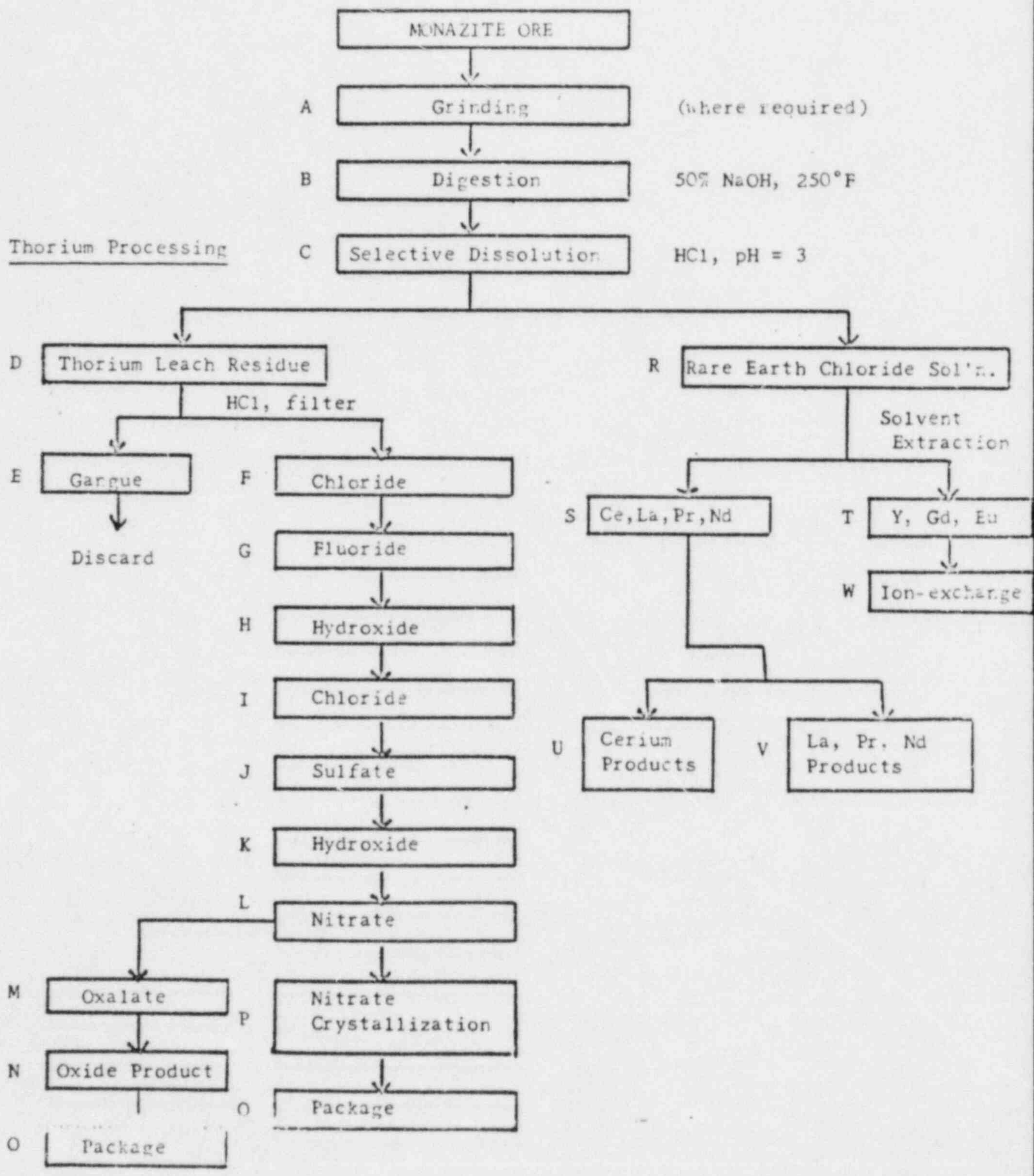
For a period of over a year during 1967 and 1968, waste effluent was radio assayed on a daily basis. Of 475 daily samples assayed for soluble radioactivity 306 were reported as N.D. and the average concentration was 0.12×10^{-6} μci/ml. The insoluble portion was assayed as well. 285 of the samples for insoluble radiation were N.D. and the average concentration was 0.36×10^{-6} μci/ml.

Most N.D. results reported are equal or nearly equal to background. Results less than 10^{-7} μc/ml are also reported as N.D.

Additional environmental water samples are collected monthly from the plant storm sewer system and nearest river. These samples are analyzed by the described procedure for thorium and to date there is no evidence of thorium contamination in these streams.

8. (A flow diagram of the plant production operation, a diagram of the plant layout, indicating areas and points in the process where dust is generated).

The process essentially is the caustic digestion method for extracting rare earth and thorium values from monazite ore.



9. (A description of dust collection and ventilation equipment that are utilized during plant operation, including type, capacity and location of such equipment, eg., ore transfer points, crushing, grinding, etc., and an analysis of the efficiency of the equipment as designed to control or prevent the release of airborne radioactivity to the environs.)

Dust collection equipment is indicated on the floor plans by a star (*). The star indicates the point of operation where airborne radioactivity is generated and thence collected.

A. Ore may or may not be ground, depending on quality. The grinding operation is provided with ventilation control and dust collecting equipment which prevents airborne radioactivity exposure in excess of CFR-20 limits for the operator or operators who attend the operation and for unrestricted areas.

Ore is not ordinarily roasted, although equipment is available for this. (See floor plan titled "Sand Roasting Shed-Bldg. 4A.") A Dracco 52 bag collector and a Schneible Multiwash Scrubber are located on the roof of Building 4A. Dust laden air is filtered through the bag collector. The filtered air then passes through the scrubber and the dust free air is then discharged to the atmosphere. The system loading is approximately 12,500 C.F.M. The air relocities at the various hoods (*) have a minimum of 125 F.P.M. Capture velocity is approximately 100 F.P.M. During past operations several hundred air samplings have been taken resulting in no overexposures for any of our personnel.

B. Ore is placed into a Monazite sand hopper (see floor plan titled "Bldg. 9 1st Floor area"). The ore is lifted to the 4th floor by a bucket elevator. The sand hopper is hooded and ducted to a Dracco 3-compartment No. 40 bag collector which is located on the 4th floor roof.

The elevated ore is discharged into a surge bin. (See floor plan "Bldg. 9 Fourth Floor Equipment Layout.") The surge bin discharged into charging buckets positioned on a weighing scale. This operation is enclosed in a hood ducted to the dust collector.

Air velocities at the face of the hoods are:

1.	1st Floor Sand Hopper Hood	135 F.P.M.
2.	4th Floor Weighing Station	110 F.P.M.

Capture velocity is approximately 75-100 F.P.M., and the system loading is approximately 8,000 C.F.M.

Hundreds of air samplings have shown no excessive exposures to airborne radioactivity for our personnel working at the sand hopper or weighing station.

The charging buckets are emptied into reaction pots containing hot liquid caustic soda. Vapors and gases from the reaction are exhausted from the pots, and scrubbed in wet scrubbers before discharge to the atmosphere.

From this point through many process steps there is no significant airborne radioactivity problem.

J. (Flow diagram Step J - Thorium Sulfate)

Thorium sulfate is slowly crystallized from a thorium chloride solution using mild air agitation and a lightening stirrer. Water vapor containing a small amount of hydrochloric acid is evolved. This vapor is passed through a packed, wet caustic scrubber and exhausted into an 80' high general purpose exhaust stack. (See floor plan "Bldg. 9, 3rd Floor Layout."

L. (Flow diagram Step L - Thorium Nitrate)

This part of the process is serviced by a scrubber. (See floor plan "Bldg. 9, 2nd Floor Equipment Layout.")

Thorium nitrate feed solution is evaporated in kettles to concentrate the solution. Upon cooling, crystals of thorium nitrate are formed. During the evaporation water vapor containing oxides of nitrogen are evolved. The kettles are completely enclosed in a hood which is ventilated to a packed tower scrubber with a caustic scrub to remove the small amount of nitrogen oxides. The scrubber discharges into the general process exhaust system.

The scrubber loading is 4300 C.F.M. and air velocities measured at the opened inspection door in the hood panel are greater than 200 F.P.M.

M,N,O. (Flow diagram Steps M, N, & O - Thorium Oxide)

(See floor plan "Thorium Oxide Rooms - Bldg. 3.")

Damp thorium nitrate crystals are dissolved in water and oxalic acid added to precipitate thorium oxalate. This slurry is filtered and the damp cake is spread on trays and dried in a tray drier. The water vapor is vented directly to the atmosphere.

The trays of dried oxalate are placed under a hood and the product is scooped into ceramic ignition saggers. The saggers are placed into a muffle furnace where the oxide is formed. A slot hood shroud is fixed around the furnace door to remove dust which may occur during loading and unloading the furnace.

After ignition and cooling the saggers are dumped into a blending drum. A slot hood removes dust generated when dumping. After blending, the blending drum outlet valve is alternately opened and closed to fill the final package. A dust vent removes dust during packaging.

The various hoods and vents used in these operations are ducted to a Brady Dust Filter Model 1375.

The air velocities at the face of the various hoods are as follows:

Dried Oxalate Hood	300 FPM
Furnace Slot Hood	300 FPM
Saggers Dumping Hood	130 FPM
Packaging Dust Vent	Above 300 FPM

System loading is approximately 6100 CFM.

The Brady dust filter collector is located 60 yards north of the Building 3 thorium oxide room. It is contained in a separate room as shown on the drawing titled "Bldg. #1 Floor Equipment Layout."

10. & 11. (A description of the survey program which is followed to determine concentrations of airborne radioactivity within the plant, including the make, model number and capacity of sampling devices, and your procedure for sample analysis. Include a description of:
   a. Each sampling location in respect to operating personnel.
   b. Each sampling location in respect to process operation.
   c. The frequency (for a & b).
   d. Surveys made during maintenance operations.)

Concentrations of airborne radioactivity within the plant are determined for the following:

A. Breathing zone of the operator while at the point of operation where dusty radioactive material is handled. (5 minute air sample)

B. Specific work area the operator occupies when not at the point of operation. (1 hour air sample)

C. General plant areas which the operator or others may occasionally or frequently occupy. (1 hour air sample)

D. During maintenance of thorium processing equipment containing dusty material.

Many of the operations are quite intermittent. Air samplings are not taken at the point of operation during down time. General air samples are obtained, however, in each building and on each building floor which contains thorium operations, unless these areas are shut down and only rarely occupied. A general air sampling is also made in a non-thorium operating area for "background" information. General air samples are taken monthly.

Breathing zone, point of operation air samples are indicated by solid circles on the attached floor plans. These samples are taken at one-half of the points shown every other week in such a manner that a sample is taken at each point once each four weeks, except at those points where no operations are conducted during the four week period.

A specific work area sample is taken whenever a breathing zone sample is found to contain more than 3×10^{-11} μc/ml natural Th, 7×10^{-10} μc/ml Ra224, 1×10^{-7} μc/ml Bi212, or 3×10^{-7} μc/ml Rn220. Under these circumstances the operators time in the various areas he occupies is documented, and his potential 40 hour exposure calculated.

Upon learning that maintenance work is needed on equipment containing radioactive material an assessment is made of the particular job in question. If it is determined that a potential airborne contamination problem could exist then an air sampling program is established after all efforts are made to minimize the problem.

We have three air sampling devices which were designed and constructed by our personnel. Each sampler has a timer, an air pump, flow meter, air flow adjustment, and a filter paper holder. The air flow meter is calibrated using a gas meter. The air sampler is set to draw 35 liters of air per minute through a Whatman No. 41 paper which is 1.25 inch in diameter.

We use a gas flow proportional alpha counter in the "windowless" position to analyze our air samples.

Alpha counting is done as follows:

I. In cases where daughter activity is <u>more</u> than negligible and at any new point of operation, the standard formula for computing activity is:

μ Ci/ml = C/M x d/c x 1/T x 1/V x 1/0.7 x 1/K

Where C/M = counts per minute from the sample.

d/c = disintegrations per count (from alpha standard source)

T = Sampling time (minutes)

V = Volume sampled (= 35,000 ml)

1/0.7 = Filter paper absorption factor

and K = factor for converting d/m to μ Ci (= 2.22×10^6)

A. The sample is counted 1 hour after sampling and the gross activity calculated using the standard formula. At this point in time the Rn220 has died off and most of the alpha count is due to Bi212.

B. The sample is counted again 10.6 hours after sampling. This is a half-life of Pb212 and half of the Bi212 is also gone. Both of these at this point are the result of half of the Rn220 originally present.

1. The standard formula times 2 = Rn220 activity.

2. To obtain the Bi212 activity the standard formula calculation is multiplied by 0.9. This product is subtracted from the gross activity found in A, and the difference is multiplied by 2.

C. The sample is counted again 106 hours after sampling.

This is 10 half-lives of Pb212 and all of the short lived daughters originally present are gone.

The standard formula is calculated and divided by 1.7 = Ra224 activity.

D. The sample is counted again 465 hours after the sample was taken. At this point an apparent equilibrium has been established and we have nearly 6 alpha activity which is close to the amount at secular equilibrium.

$$\text{Th(nat)activity} = \frac{\text{Standard formula} - .1 \text{ Ra224 activity}}{5.9}$$

II. In cases where daughter activity is negligible counting is done 106 hours after the sample was taken.

The standard formula is divided by 6 to obtain the Th(nat) activity.

III. Each day the alpha standard is counted to assure that the counter is reliable.

Sample and background counts are properly taken to assure a 95% confidence level. We should detect a minimum of $9X10^{-11}$ μc/ml Rn220 and/or Bi212. For Th(nat) we should detect 2×10^{-12} μc/ml, and for Ra224 7×10^{-11} μc/ml. This applies to a 5 minute sample time. An hour sample would show at least 10 times greater sensitivity.

12. (A description of the procedure followed in determining the average daily and weekly exposures to airborne radioactivity for each employee who frequently or occasionally occupies areas where air contamination exceeds M P.C. values specified in 10 CFR 20.)

We are not now using any operation which continuously causes an airborne concentration in excess of 3×10^{-11} μc/ml of natural thorium in a restricted area during a 40 hour work week outside of ventilation control equipment.

There are a few operations which may for short periods of time exceed 3×10^{-11} μc/ml of natural thorium in the air at the point of operation. Thus there is a possibility that on a 40 hour basis an airborne concentration greater than 1 M.P.C. might exist.

Whenever a 5 minute operators breathing zone sample shows greater than 3×10^{-11} μc/ml of natural Th the operators time at the point of operation is calculated. A 1 hour air sample is taken in the environs of the area where the operator spends most of his time. The time weighted exposure including the breathing zone sample and general air sample is calculated. If the calculations show that an average of 1 M.P.C. could be exceeded during a 40 hour work week then immediate steps are taken to correct the problem. If ventilation control equipment is found deficient it is repaired. If the operators handling methods are improper he is re-instructed. As a last resort employee rotation may be used.

It is extremely rare that a general area air sample exceeds 1 M.P.C. and these operating areas are occupied so little by personnel, other than the operator, that we do not propose to document the time of an occasional occupant.

13. (If treatment or disposal of licensed material by incineration is anticipated, an application should be made in accordance with 10CFR20 sec. 20.305.)

In conformance with 10CFR20.305 we request that our license include a provision enabling us to incinerate monazite ore bags and other combustible trash.

We use a hand fed Model Co-200 incinerator equipped with a gas after burner built by the C.O. Hendrikson Company. The following data applies:

a. Trash burning capacity of incinerator - 200 lbs/hr.
b. Exhaust gas volume in stack corrected to $70^{o}F$ - 300 C.F.M.
c. Stack height - 30 ft.
d. Particulate emission-0.17 grains per standard cubic foot.
e. Expected maximum operating time - 10 hrs/wk.

f. Micro curies (Th(nat) of exhaust gas within stack - 8×10^{-12} µc/ml (corrected to 70^{o}F).
g. Expected yearly average concentration of Th(nat) within stack gas - 0.46 M.P.C. (Background neglected).
h. Ash & residue (monazite sand) - 20% of trash weight.
i. Thorium content of ash & residue - 6% (1.2% of trash weight).

Before incineration the operator cleans out the ash from the previous days burning. The ash & residue is placed in boxes or drums and stored for possible future reclaiming of values.

Twice monthly, an hour-long air sampling in the general operator work area is made and the exhaust stack is sampled for radioactivity in the particulate emission.

14. (A description of plant discharge stacks including stack heights, types and concentrations of effluents discharged, method for controlling release of radioactive material, and methods for determining the concentration of radioactive material released to the environs.)

We have a total of 10 stacks which service our thorium operations. These are:

1. Bldg. 9-General purpose process exhaust system, 3rd floor roof. This stack is 80 ft. from ground level. Many processing tanks are connected to the general exhaust system. These tanks are all part of the "wet" process. The discharge from this stack is almost entirely air and water vapor.

2. <u>Bldg. 9-Dracco Dust Collector Stack, 4th floor roof.</u> This stack is approximately 130 ft. high. This equipment is described in Section 9B.

During operation, once every other week, hour-long air samples are taken at the point of discharge and other areas on the roof. Most of the time the air sample results are well below 1 M.P.C. Th(nat) for unrestricted areas. On the rare occasion that the discharge shows higher radioactivity than usual corrective maintenance is done to correct the situation.

3. <u>Bldg. 9-Water Scrub Shelf Tower, 4th floor roof.</u> This equipment is described in Section 9B. The discharge from this tower is 120 ft. above ground level.

4. <u>Bldg. 3-Thorium Oxide Process Oxalate Precipitation.</u> The kettles used to dissolve damp nitrate and precipitate the oxalate are enclosed in a hood which is vented by a stack 30 ft. high. The stack discharges water vapor. (See section 9 M,N, & O.)

5. <u>Bldg. 3-Thorium Oxalate Drier</u>. The oxalate drier (see section 9 M,N & O) stack vents water vapor and products of natural gas combustion at a height of 30 ft. from ground level.

6. <u>Bldg. 3-Muffle Furnace.</u> The furnace (see section 9 M,N,&O) exhaust stack discharges CO_2 and gas combustion products at a height of 30 ft.

7. <u>Dust Collector for ThO_2 Process - Bldg. 3.</u> The collector stack discharges at a height of 40 ft. above ground level. Air sampling similar to that described above (2) for the dust collector stack on the 4th floor roof is performed.

8. <u>Ore Roasting - Bldg. 4A</u>. As described in 9A, the ore roasting equipment is serviced by a dust collector and a wet scrubber. This combination very effectively removes dust before the ventilation air is discharged from the scrubber stack which is approximately 60ft. in the air. Air samples are obtained on the roof of this building.

9. Incinerator. See Section 13 for details.

10. Shipping Warehouse Small Package Station. Occasionally we need to make small packages of thorium nitrate or oxide. The radioactive material is handled within a dust collector hood with the operator outside. The collector is a Torit Model 124 bag collector. The clean air discharged 10 ft. above ground through a wall of the building. Loading is 2800 C.F.M.

As a double check on our dust collection effectiveness we take at least six (6) air samples each month around the periphery of our plant property. Also, on a weekly basis, outside air samples are collected east and west of our plant at a distance of approximately one-half mile.

Roof top samples, fence line samples and remote samples over the past few years indicate we are not exceeding regulations covering airborne radioactivity in unrestricted areas.

15. (A description of the method for determining exposures of employees to external radiation. For film badge studies, indicate number and category of personnel involved in the program.)

A film badge program is used to determine the exposure of employees to external radiation.

All chemical operators, laborers, maintenance men, and immediate supervisors of these employees are required to use film badges. Laboratory and other personnel who either work with or frequently visit areas where radioactive material is handled or stored also are required to use film badges. Persons whose duties are not likely to involve them with radioactive material handling, and who seldom visit operating or storage areas are not required to use film badges.

Chemical operators and laborers who are considered "thorium handlers" are on a weekly badge service to minimize the possibility of over-exposure. All other personnel in the film badge program are on a monthly badge service schedule.

We currently have 30 persons on weekly badge service and 115 on monthly service. These numbers will vary depending on production manpower requirements.

At a minimum, Gamma meter surveys are conducted during the time that monthly general air samples are obtained. Records of these surveys are kept.

16. (A description of your methods for contamination control, including provisions for monitoring and the levels of contamination at which decontamination is performed.)

Our housekeeping program includes wet scrubbing of the floors daily in areas where thorium containing material is handled. In the case of a spill, the operator is instructed to clean it up as soon as practical. The level at which decontamination is necessary is that amount which is visible to the eye. A monitoring survey for surface contamination, therefore, is essentially a visual inspection. Survey meters are used to distinguish between radioactive and non-radioactive contamination.

Personal protective equipment provided for employee use when needed includes hard hats, safety glasses, chemical goggles, face shields, plastic jackets and pants, rubber safety shoes or boots, assorted glove types and styles, dust and fume respirators, and other miscellaneous equipment.

Shower and locker room facilities are available for all operating personnel. A clothes washer and dryer is also available. These people are instructed to bathe or wash thoroughly after their work shift. They are also instructed to promptly wash off any thorium material which may accidentally spill on their skin.

Approximately twenty (2) smear samples are collected and analyzed monthly to measure radioactive contamination levels in the thorium processing areas, locker and luncheon facilities. All thorium product containers are surveyed and smear tested for contamination prior to shipment.

17. (A copy of the written radiological safety operation instructions supplied to employees. These instructions should include provisions for personal hygiene, including washing prior to eating or leaving the plant, instructions for wearing personnel monitoring devices, and instructions for cleaning up dust and spills within the plant.)

See enclosed "Radioactivity Statement" and Page 18 of booklet titled, "General Safety Rules and Safe Procedures."

Revised June, 1972

RADIOACTIVITY STATEMENT

General Instructions for Handling Radioactive Materials in the West Chicago Plant

Employees of Kerr-McGee Chemical Corp. are hereby informed of the occurrence of radioative materials and radiation in the West Chicago Plant.

The Corporation is required by law to explain the safety problems associated with handling radioactive materials. In a sense there are no safety problems concerning radioactivity in the plant. That is, careful observations have failed to show any employee has ever been injured by radioactive material during the nearly sixty years this plant has operated. The reason for this is that radioactivity is present at levels very low compared to those known to be harmful. The exact level at which radioactivity becomes harmful has not yet been determined. Scientists are in universal agreement that exposure of normal persons to radioactive material produces no beneficial results. Consequently, the Atomic Energy Commission (AEC) has set very low levels of radiation and of airborne concentrations of radioactive material to which persons handling licensed material such as thorium may be exposed. The Corporation provides equipment such as hoods with forced draft ventilations, dust masks, gloves, etc., and follows good housekeeping procedures such as sweep-downs and wash-downs. No employee exercising common sense should ever receive radiation in excess of the limits permitted by the AEC, or be present in concentrations or airborne radioactivity in excess of permissible limits.

By observing some simple rules, an employee can keep his exposure well below even the very low limits allowed by the AEC. The basic principle is to avoid unnecessary contact with radioactive materials, such as monazite ore or thorium concentrates. Following are some of the ways of cutting down on exposure:

1. Most Important — Avoid any dust unnecessarily.
2. Wear a dust mask faithfully on the operations and at the times required. Your foreman will instruct you as to when to wear, how to wear, and how to care for your mask.
3. Do not make unauthorized visits to dusty operations.
4. Do not rest on monazite bags or drums of thorium or even stay next to them unnecessarily.
5. If material is accidentally spilled, clean it up as soon as practical; or if you are in doubt as to proper procedure, tell your foreman. If the material can be recovered by sweeping it up, avoid raising dust. Spilled solutions are to be hosed down. If a thorium solution or powder is accidentally spilled on your skin, wash it off before doing anything else. Other material should be washed off as soon as practical. Spilled thorium oxide powder is a special case and is to be vacuumed up, unless the amount is so large as to make this impractical. For example, if a bottle of thorium oxide should break, it would be better to carefully shovel the bulk of it up while wearing a dust mask and gloves. After vacuuming, the area is to be wet-mopped with soap and water. Discharge the used water to the waste drain.
6. When you leave your work station, wash your hands thoroughly, especially before eating.
7. Your badge measures the radiation you receive from external sources. Wear your badge faithfully. Avoid splashing material on it.

Should you ever be exposed to more radioactivity in this plant than permitted by the AEC, you and the AEC will be so informed in writing by the Corporation as required by law. Such notice will not indicate that you have been injured in any manner. If there are any over-exposures in this plant, they will be slight. Also, the AEC has stated that considerably higher exposure limits than those permitted would not result in excessive hazards. The notifications serve as checks on the efficiency of our radiation protection program. It is good common sense for you to do your part to limit your exposure and that of your fellow worker to such low levels that we never have an over-exposure.

KERR-McGEE CHEMICAL CORP.

I have read the above statement concerning radioactivity at the West Chicago Plant.

Date: ____________________ Signature: ____________________

JUL 14 1972

L:MB:RLL
(40-2061)
STA-583, Amendment No. 2

I, II

Kerr-McGee Chemical Corporation
ATTN: Mr. O. L. Daigle
Plant Manager
258 Ann Street
West Chicago, Illinois 60185

Gentlemen:

Pursuant to Title 10, Code of Federal Regulations, Part 40, Item 8 of Source Material License No. STA-583 is hereby amended to include the date of June 13, 1972. and

All other conditions of this license shall remain the same.

In order to complete our required distribution, we need two additional copies of Drawing No. C-11083-4 submitted as an enclosure to your June 13, letter.

FOR THE U. S. ATOMIC ENERGY COMMISSION

Original signed by
Robert L. Layfield

Robert L. Layfield
Materials Branch
Directorate of Licensing

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State Health
Docket File
Branch R/F
Division R/F
RLLayfield's R/F
RO:III
CLHilliard
CRBuchanan, L
ACaball, DR:ADM

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OCT 16 1972

OFFICE	L:MB
SURNAME	RLLayfield:cls
DATE	7/11/72	7/ /72

Form AEC-318 (Rev. 9-53) AECM 0240 ☆ GPO 1970-407-729

JUL 1 4 1972

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7/11/72	7/ /72

JUL 1 4 1972

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(40-2061)
STA-583, Amendment No. 2

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Materials Branch
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